



Evaluating, understanding,
& improving our waters

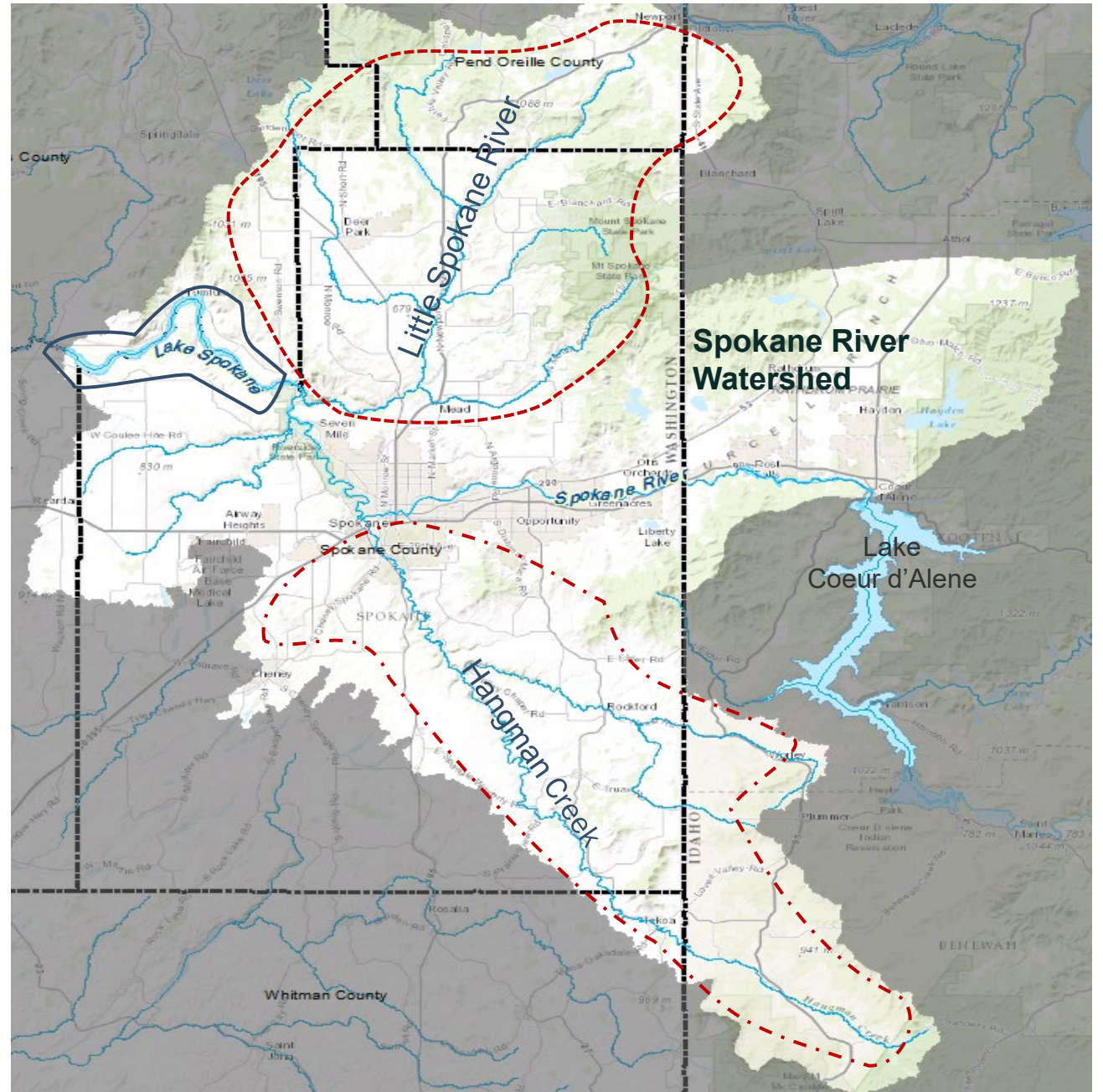
The Spokane River Basin

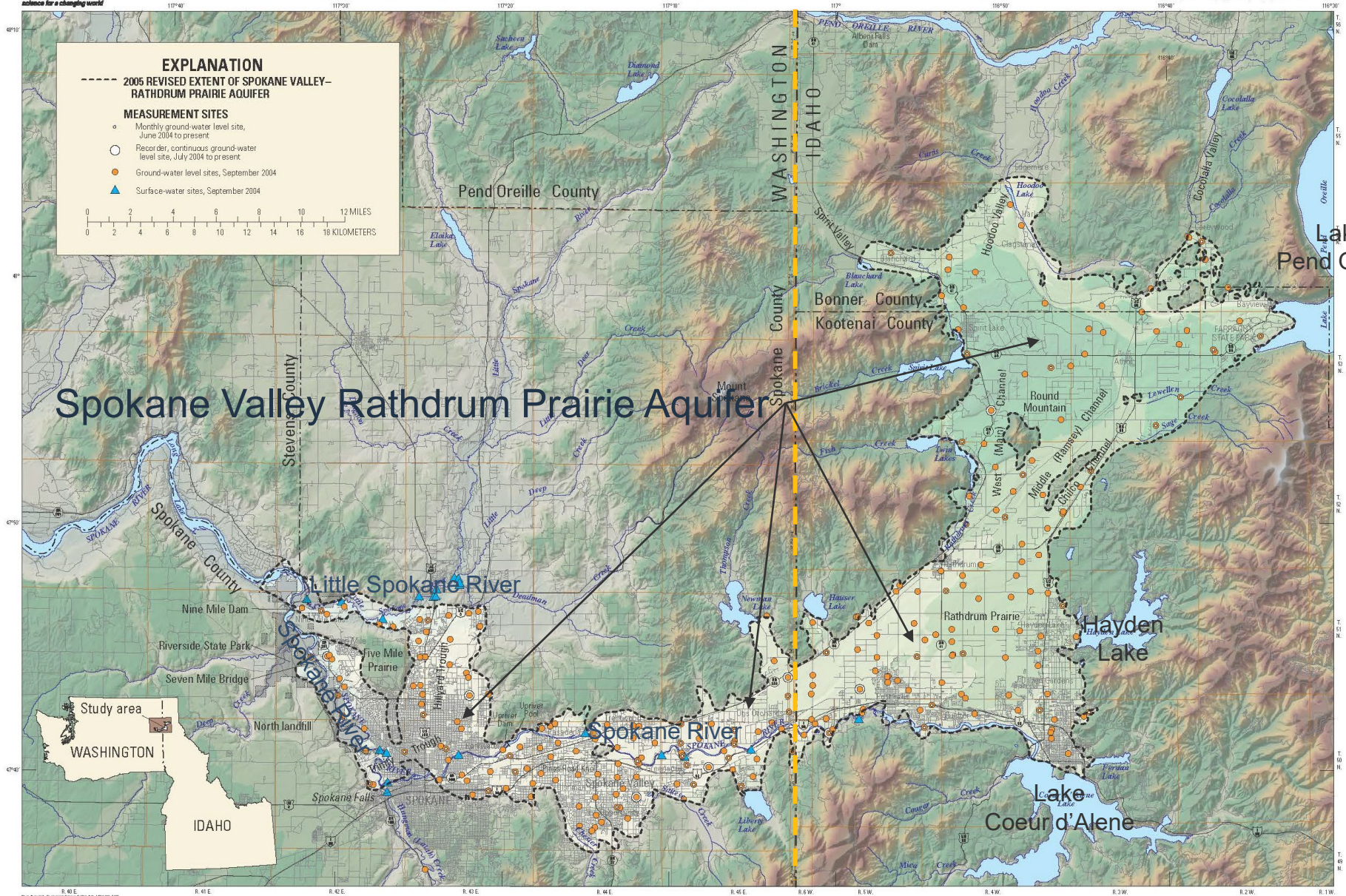
Presented by:
Cathrene Glick, *LG, LHG, LEG*
Dept. of Ecology
Environmental Assessment Program

April 2023

Overview of the Spokane River

- Originates From Lake Coeur d'Alene
- Augmented with inflows from:
 - Hangman Creek Tributary
 - Little Spokane River Tributary
- Flows into Lake Spokane





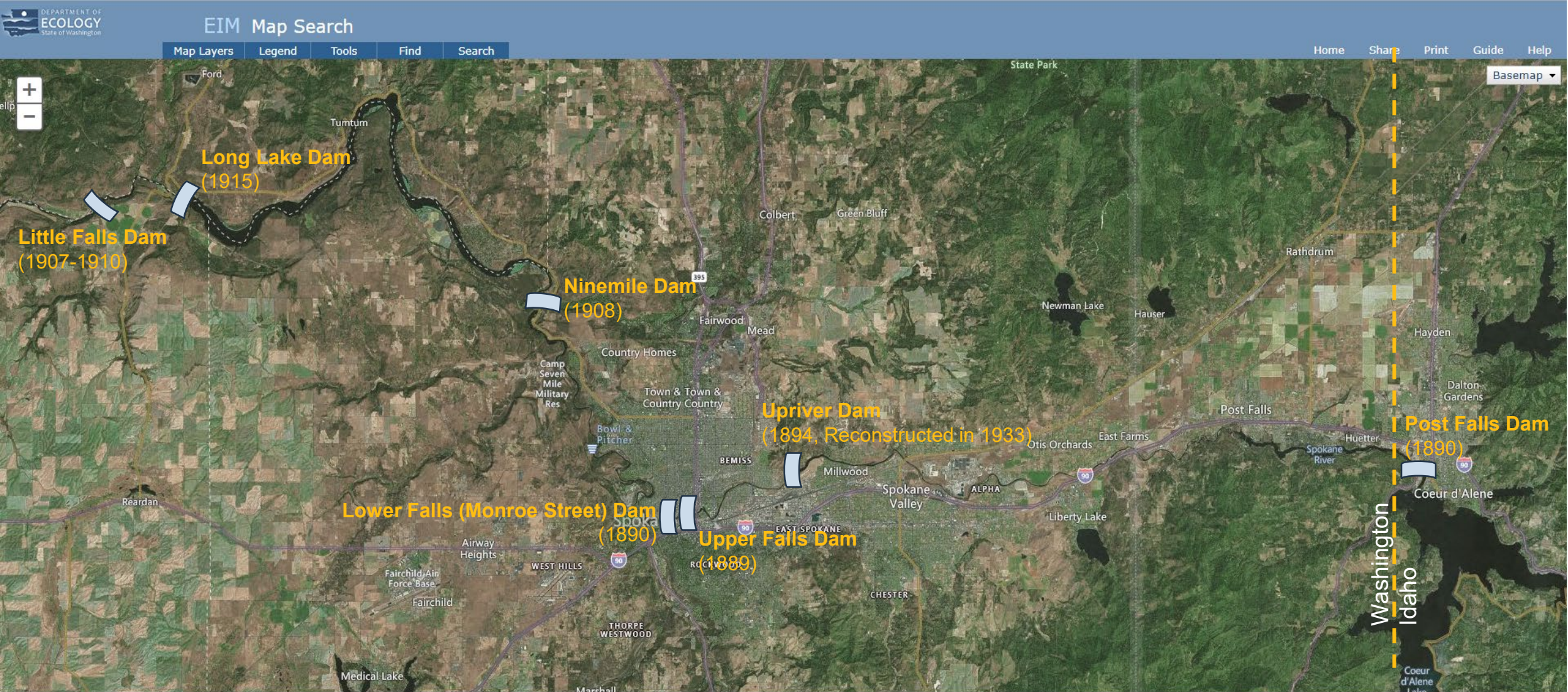
Spokane Valley Rathdrum Prairie Aquifer

Lake Pend Oreille

AREAL DISTRIBUTION OF GROUND-WATER AND SURFACE-WATER MEASUREMENT SITES, SPOKANE VALLEY-RATHDRUM PRAIRIE AQUIFER, WASHINGTON AND IDAHO, 2005

By
S.C. Kahle, R.R. Caldwell, and J.R. Bartolino
2005

DAMS ALONG THE SPOKANE RIVER



Historic Water Quality Issues

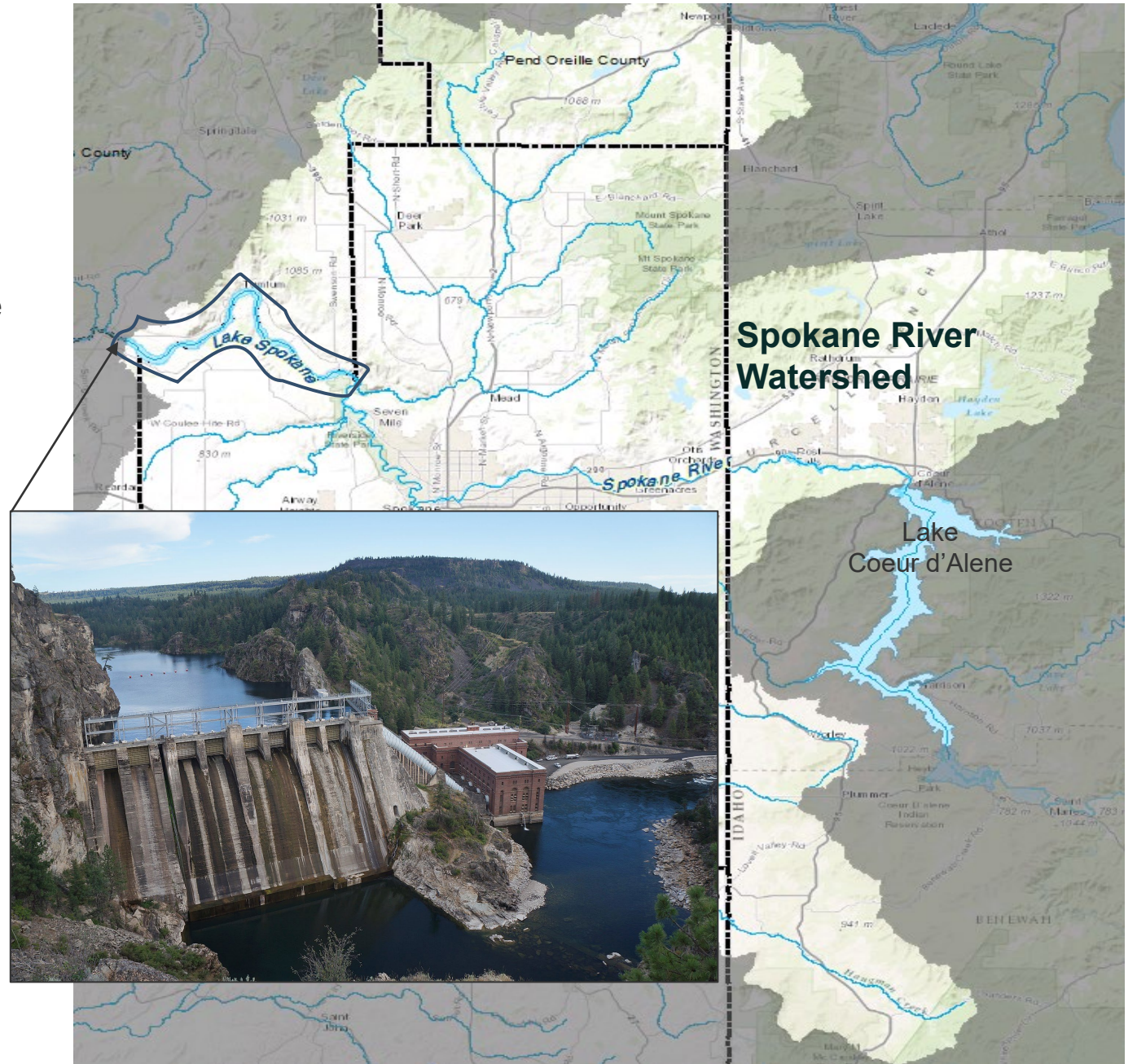
In 1889, Spokane built a sewage system that dumped raw sewage directly into the river, which was visibly noticeable by 1920.

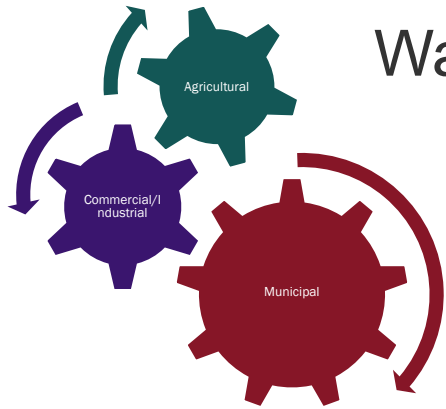
The Spokane River contained some of the highest concentrations of heavy metals of any river in the state resulting from pollution upstream mining and smelting sites.

In 1935, the state health board declared the Spokane River to be “grossly polluted”.

Lake Spokane (*aka Long Lake*) Created in 1915 by the Construction of Long Lake Dam

- Increases Residence Time of Water
- Reductions in Dissolved Oxygen in Water
- Accumulation of Nutrients in Water
- Increase Algae Blooms
- Blocks Salmon Migration in River





Water Quality Improvements Over Time.....

1989 - Liberty Lake Sewer and Water District (LLSWD) led the way regionally and nationally with banning phosphorus in laundry detergents.

1993 - Nationwide ban of phosphorus in laundry detergents.

1994 - Washington statewide phosphorous detergent ban passed

2005 - LLSWD became the first utility to ban phosphorus dishwasher detergents.

2005 - LLSWD bans the use of lawn fertilizer containing phosphorus within their boundaries.

2008 – Spokane, Whatcom and Clark Counties adopt a phosphorus dishwasher detergent ban

2009 - Proctor and Gamble announced a plan to eliminate all phosphates from its dishwasher detergent “Cascade”

2010 - Washington State extended statewide ban on automatic dishwasher detergents containing phosphorus.

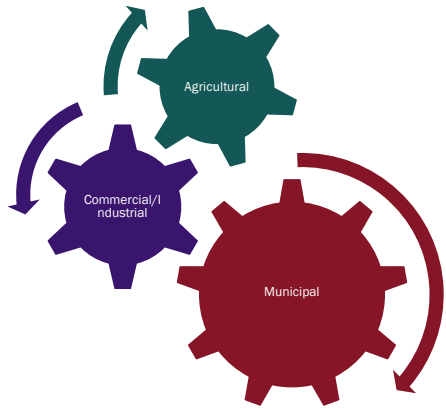
2010 - The Lands Council proposed a phosphorus fertilizer ban

2011 - Washington State passed Engrossed Substitute House Bill (ESHB) 1489, which prohibits the application of fertilizers containing phosphorus to “land, including residential property, commercial property, and publicly owned land, which is planted in closely mowed, managed grass.” (ESHB 1489, 2015).

2013 - Washington State Fertilizer Ban became effective.

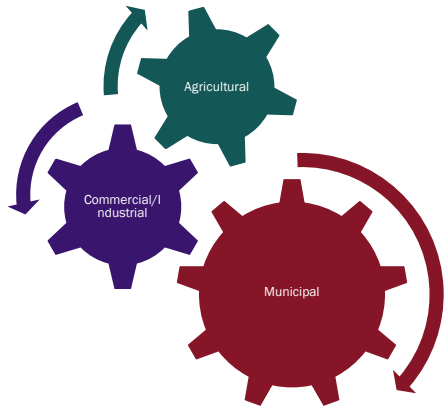
2014 - Proctor and Gamble announced a plan to eliminate all phosphates from its laundry detergent worldwide (25% of global market)





Since 1983, Spokane County has prioritized hooking up septic systems located over the aquifer to the sewer system. Between 1984 and 2001, the County connected 20,100 homes and businesses to the sewer (Moss 2015). In 2001, under an updated Comprehensive Wastewater Management Plan (CWMP), the County created the Septic Tank Elimination Program (STEP) with the goal to hook up all developed parcels in the STEP areas to the sewer by 2012.

The City of Spokane has also participated in the STEP program, eliminating several thousand septic tanks. The City's objective was to intercept and connect all remaining on-site wastewater systems in the City's sanitary sewer service area and over the aquifer sensitive area. It was estimate that approximately 800,000 gallons of effluent a day would be intercepted and prevented from draining over the aquifer.



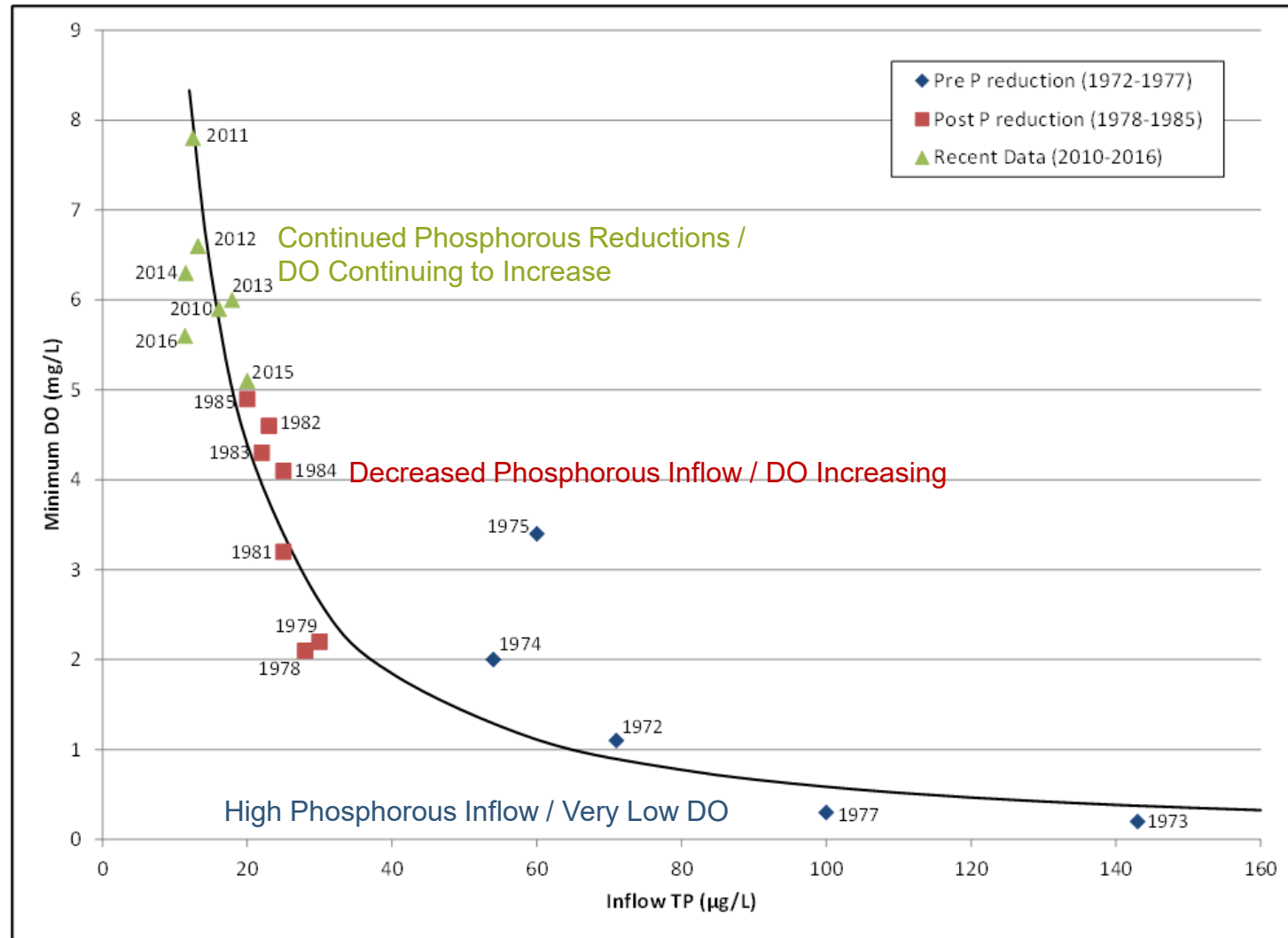
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Spokane Conservation District's Water Resources Department and landowners have completed numerous projects within Spokane County that will help reduce the amount of phosphorus entering Lake Spokane

- 81 projects planted riparian areas (stream banks) with native trees and shrubs which helps reduce stream bank erosion. Approximately 19 miles of stream were planted.
- 50 projects applied BMPs to agricultural land. The majority of the BMPs were to convert from conventional tillage to direct seed. About 13.6 square miles are no longer conventionally tilled, saving an estimated 52,000 tons of soil.
- 29 projects installed fencing to keep livestock away from over a mile of surface water. Fencing livestock away from streams keeps manure, urine, and sediment out of the water.
- 15 projects reduced stormwater by directing runoff to areas where it can soak into the ground.
- 9 projects were installed to stabilize eroding shorelines.

Inflow Concentrations of Total Phosphorous To Lake Spokane vs. Dissolved Oxygen Content 1972 - 2016



June-October volume weighted mean inflow TP concentration related to minimum volume weighted hypolimnetic DO concentrations before and after advanced wastewater treatment (Avista, 2017)

COMPARISON OF LAKE SPOKANE DISSOLVED OXYGEN CONDITIONS

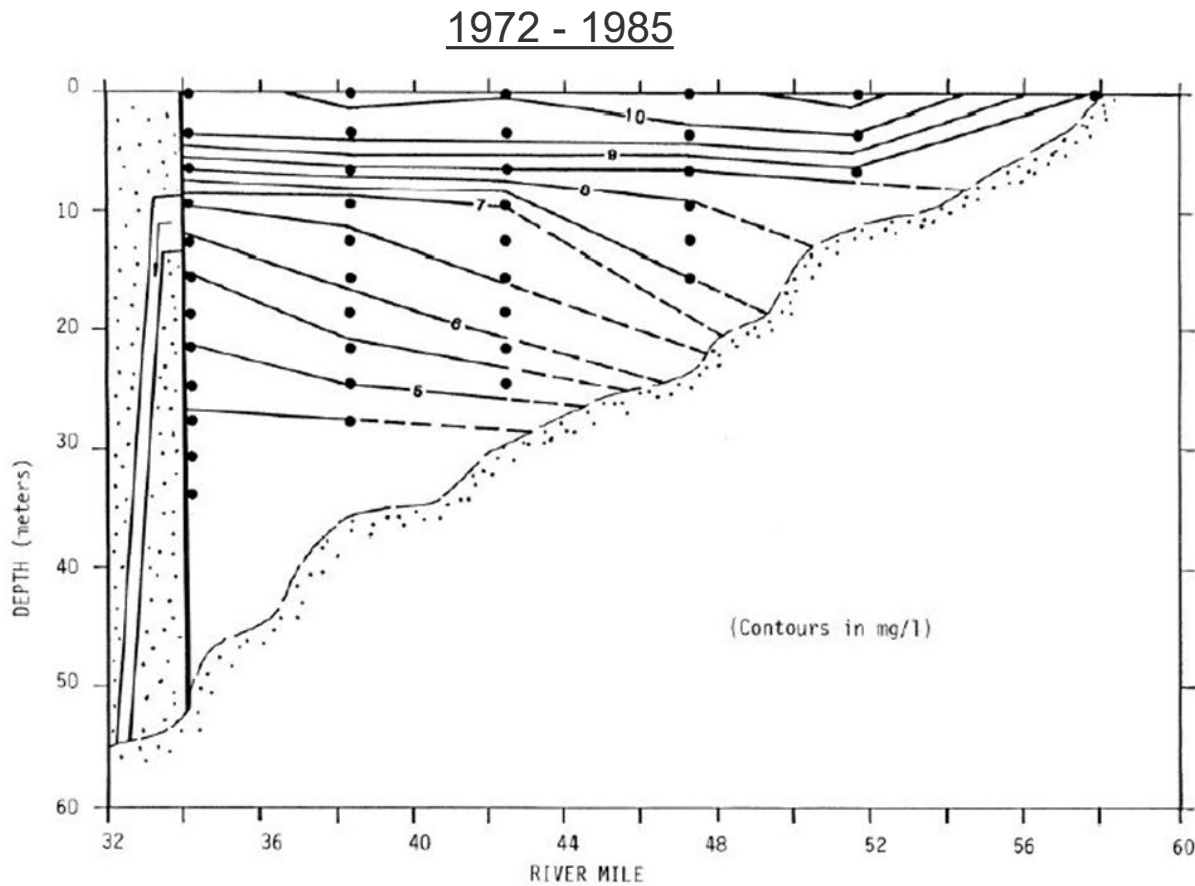


Figure 14. Average June - October DO contours in Lake Spokane, 1972 - 1985 (Patmont 1987).

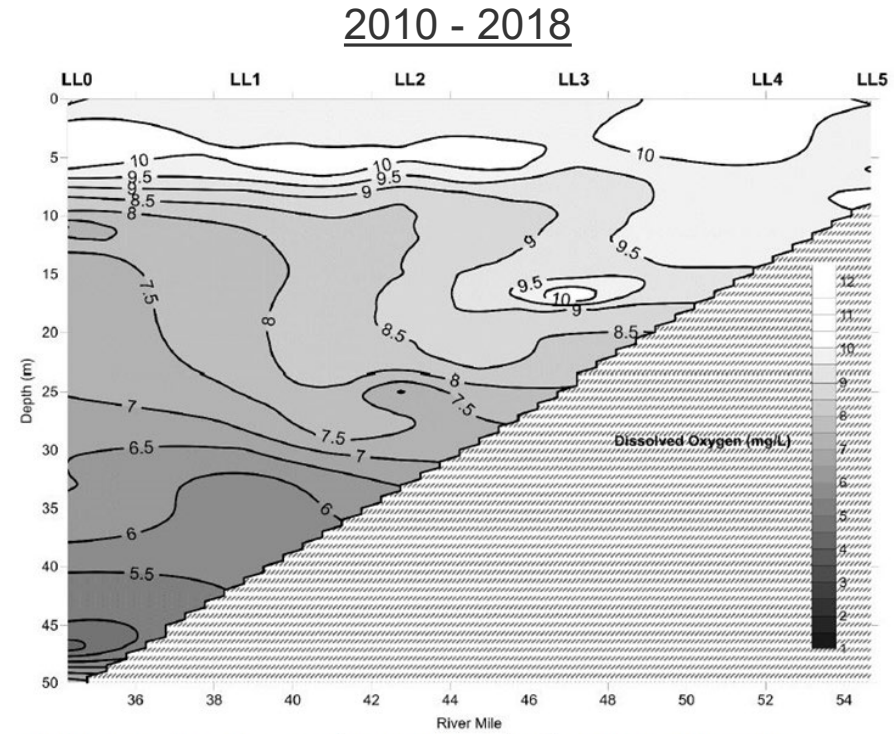


Figure 15. Average June - October DO contours in Lake Spokane, 2010 - 2018.

Source: Avista DOWQAP 2019 Annual Summary 8-Yr Report

Environmental Assessment Program Ambient Water Quality Stream Monitoring

Monitoring the Spokane River Watershed Since 1959

WASHINGTON STATE Department of Ecology
Freshwater Information Network Search Environmental Information Management System
Search Home All Studies Locations Results Groundwater Help Center Contact EIM EIM News
EIM data last updated on Thursday, January 26, 2023

FIN Search

Filter Tools Legend Layers

Spatial Extent

WRIA
01 - Nooksack
02 - San Juan
03 - Lower Skagit-Samish
04 - Upper Skagit
05 - Stillaguamish
Clear WRIA Selection

County
SNOHOMISH
SPOKANE
STEVENS
THURSTON
Clear County Selection

Monitoring Region
 Southwest
 Northwest
 Central
 Eastern

EcoRegion
Puget Lowland
Cascades
Coast Range
Willamette Valley
Eastern Cascades

Search Data | Clear

PARAMETERS MONITORED MONTHLY:

*Conductivity, Dissolved Organic Carbon, Fecal Coliform, pH, Temp, Turbidity, SS, DO
Ammonia-Nitrogen (NH₃_N), Nitrate-Nitrite (NO₂_NO₃), Total Persulfate Nitrogen (TPN)
Ortho-Phosphate (Dissolved), Total Phosphorous*



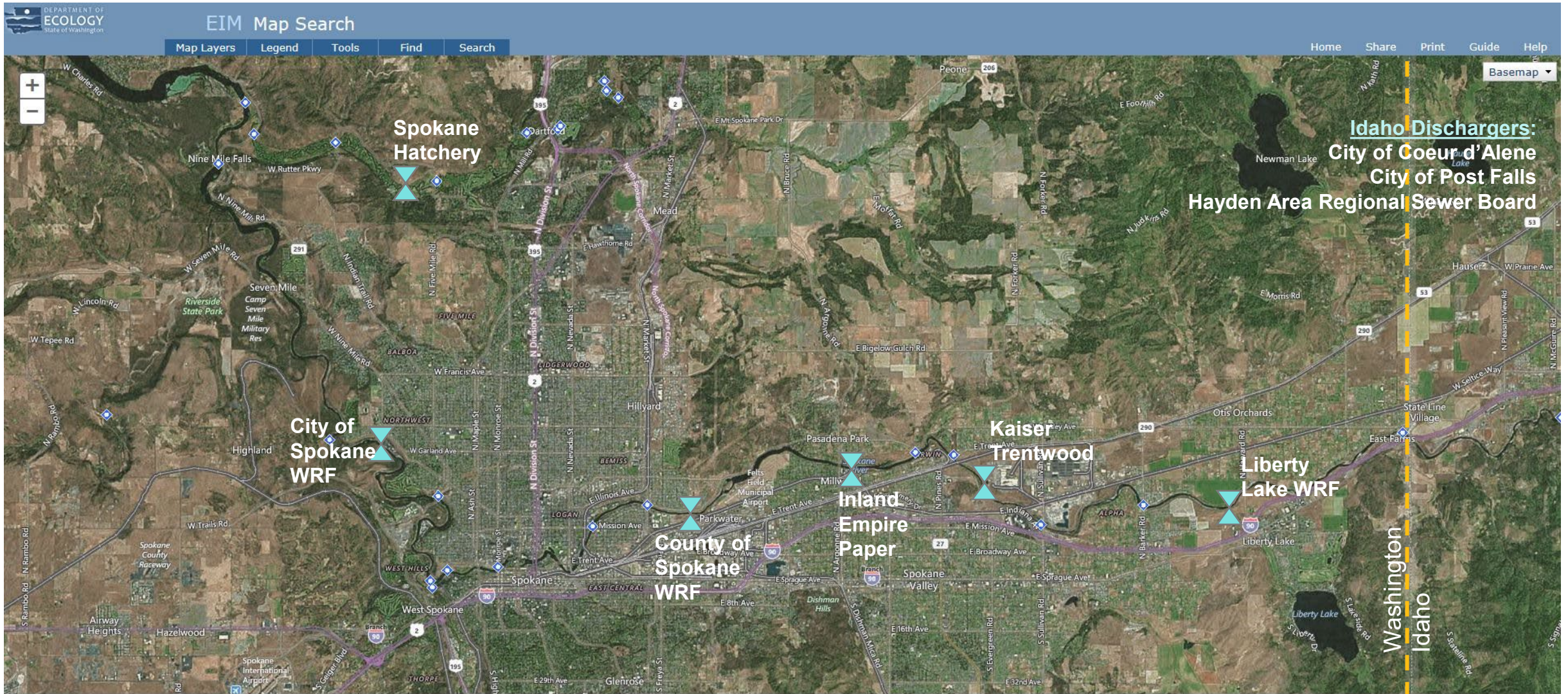
What Does Monitoring Involve?

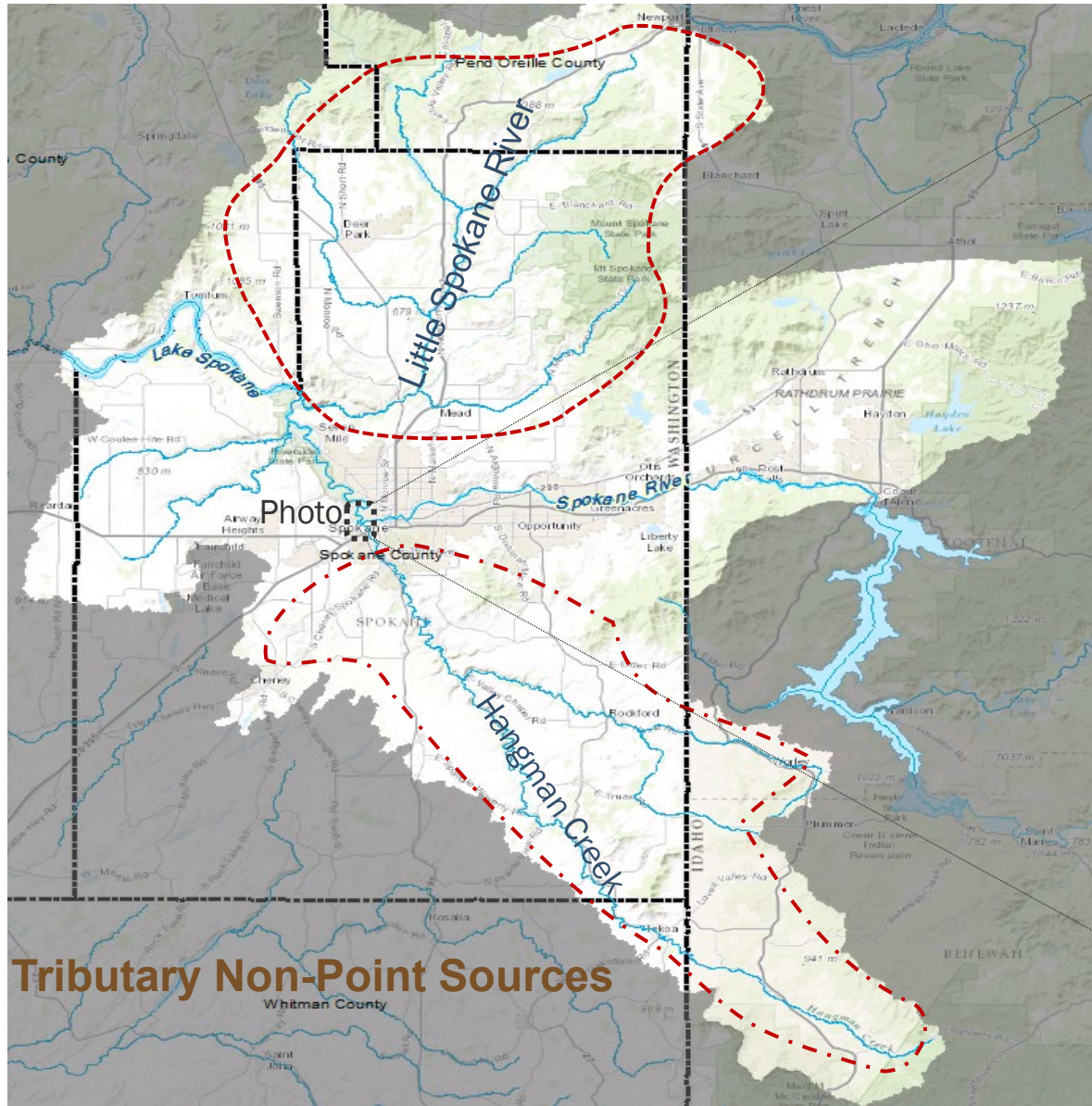
- Monthly ambient water quality monitoring
- Conducting water quality studies
- Effectiveness monitoring studies

- Collect Representative Data
- Credible & Defensible Analysis
- Statistically Significant Data Trends



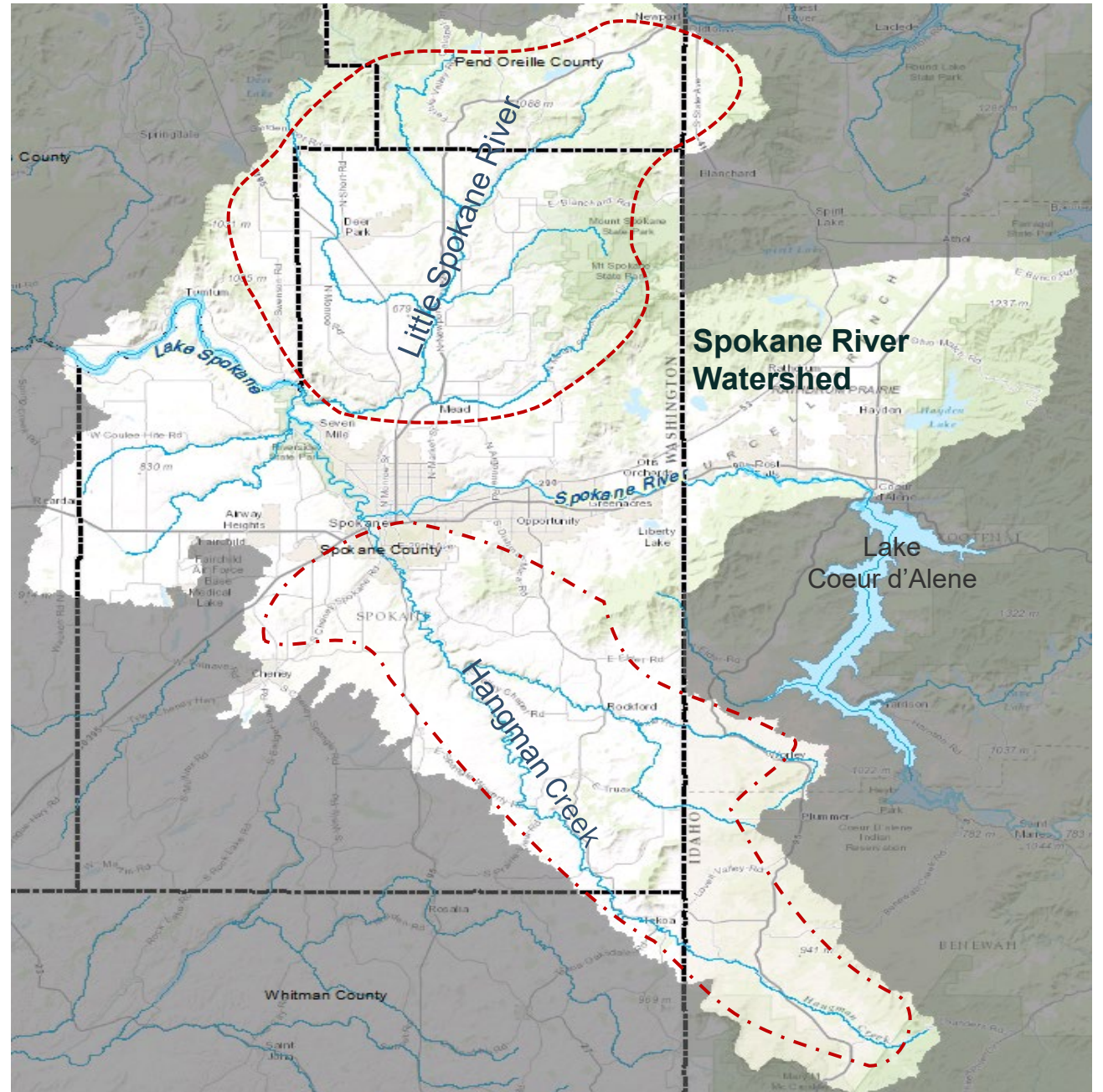
CURRENT PERMITTED SPOKANE RIVER DISCHARGE SITES





WATERSHED STUDIES TO DATE:

- 1987 The Spokane River Basin: Allowable Phosphorous Loading Study
- 2004 Spokane River and Lake Spokane (Long Lake) Pollutant Loading Assessment for Protecting Dissolved Oxygen
- 2009 Hangman Creek Coliform Bacteria, Temperature and Turbidity Total Maximum Daily Load Study
- 2010 Spokane River and Lake Spokane Dissolved Oxygen Total Maximum Daily Load
- 2011 Hangman Creek Watershed Dissolved Oxygen, pH, and Nutrients Total Maximum Daily Load Study
- 2012 Little Spokane River Watershed Fecal Coliform Bacteria, Temperature, and Turbidity Total Maximum Daily Load
- 2020 Tekoa Wastewater Treatment Plant Dissolved Oxygen, pH, and Nutrients Receiving Water Study
- 2020 Hangman (Latah) Creek Hydrogeologic Assessment, Focusing on the Latah Creek Wastewater Treatment Plant
- 2020 Little Spokane River Dissolved Oxygen, pH, and Total Phosphorus Total Maximum Daily Load Study
- 2022 Hangman Creek Watershed Nutrients and Sediment Pollutant Source Assessment



Spokane River / Lake Spokane Dissolved Oxygen Total Daily Maximum Load (DO TMDL)

Implemented in 2010

TMDL established wasteload limits for the three pollutants affecting dissolved oxygen:

- ammonia (NH₃-N),
- total phosphorus (TP)
- carbonaceous biochemical oxygen demand (CBOD)

TMDL also identified a dissolved oxygen responsibility for hydroelectric dam operations in Lake Spokane

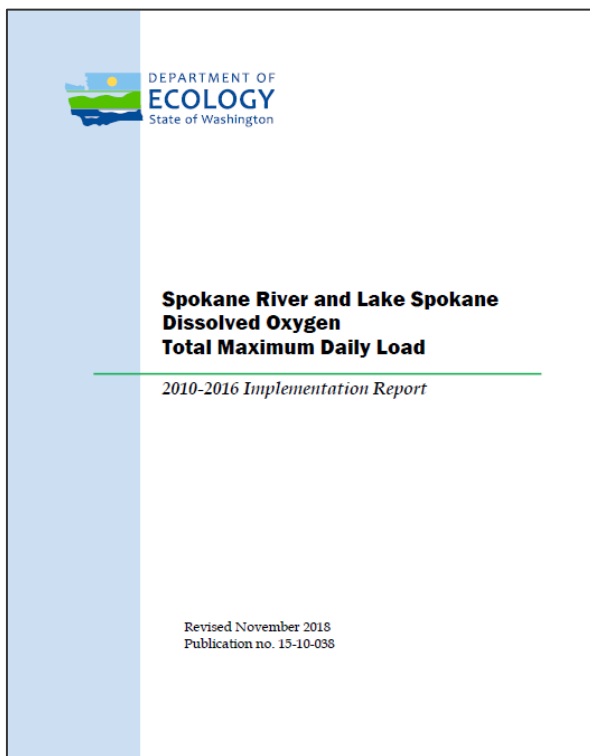


Spokane River and Lake Spokane Dissolved Oxygen Total Maximum Daily Load

Water Quality Improvement Report



Revised February 2010
Publication No. 07-10-073



For the Washington State point sources (municipal wastewater treatment plants and industrial dischargers), the seasonal (March through October) wasteload allocations are based on meeting a maximum monthly average total phosphorus concentration of 50 µg/L (micrograms per liter or parts per billion) within ten years.

Five point source dischargers in Washington on the Spokane River include”

- Liberty Lake Sewer and Water District
- Kaiser Aluminum
- Inland Empire Paper Company
- City of Spokane
- County of Spokane.

The TMDL assigned load allocations to nonpoint sources of pollution. The three tributaries (Hangman Creek, Coulee Creek, and the Little Spokane River) and the area surrounding Lake Spokane are the primary sources of nonpoint pollution to the river and lake.

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- 20 %: March – May
- 40 %: June
- 50 %: July – October

In the Little Spokane River, the allocation represents a 36 percent decrease in nutrients during the entire March through October critical season.

AVISTA CORPORATION

**LAKE SPOKANE DISSOLVED OXYGEN
WATER QUALITY ATTAINMENT PLAN**

Spokane River Hydroelectric Project
FERC Project No. 2545

Washington 401 Certification,
Section 5.6

Prepared By:



October 5, 2012

Activity		2012	2013	2014	2015	2017	2018	2019	2020	2021	2022
		Winter Spring Summer Fall	Winter Spring Summer Fall	Winter Spring Summer Fall	Winter Spring Summer Fall	Winter Spring Summer Fall	Winter Spring Summer Fall	Winter Spring Summer Fall	Winter Spring Summer Fall	Winter Spring Summer Fall	Winter Spring Summer Fall
DO WQAP Submittal	Submit DO WQAP to Ecology	x									
	Receive approval from Ecology*	x									
	Submit DO WQAP to FERC*	x									
	Receive approval from FERC*	x									
Carp Reduction	Phase I Analysis: Identify location and population of carp		x x	x x x							
	Summarize Phase I findings ^{2*}			x	x						
	Phase II Analysis: Evaluate harvest technology			x x x x							
	Select carp removal method(s)				x						
	Summarize Phase II findings ² , consult and discuss with Ecology				x						
	Determine with Ecology whether carp population reduction is reasonable and feasible to implement in Lake Spokane*				x						
	If determined reasonable and feasible, implement measure; if not, revise implementation strategy, monitoring, and schedule*					x x	x x x x x				
	If implemented, monitor for nutrient reductions					x x	x x	x x	x x	x x	x x
Aquatic Weed Management	Phase I Analysis: Evaluate feasibility of mechanical harvesting		x x x								
	Nutrient reduction evaluation		x x								
	Summarize findings ² , consult and discuss with Ecology*			x							
	Determine with Ecology whether aquatic weed harvesting is reasonable and feasible to implement in Lake Spokane*				x						
	If determined reasonable and feasible, implement measure; if not, revise implementation strategy, monitoring, and schedule*				x x	x x	x x	x x	x x	x x	x x
	If implemented, monitor for nutrient reductions				x x	x x	x x	x x	x x	x x	x x
Other Measures	Implement yearly aquatic weed controls through separate program ³			x x	x x	x x	x x	x x	x x	x x	x x
	Evaluate & implement additional measures, as appropriate					x x x x	x x x x	x x x x	x x x x	x x x x	x x x x
Monitoring & Modeling	Baseline Monitoring ⁴	x x x	x x x	x x x	x x x	x x x					
	Ongoing Habitat Analysis ⁵			x x	x x	x x	x x	x x	x x	x x	
	Site Specific Nutrient Reduction Analysis ⁵										
	CE-QUAL Modeling ⁷										
Compliance Reporting	DO WQAP Annual Summary Report*			x	x	x		x	x		
	Five, Eight, and Ten-Year Reports*						x			x	

In the TMDL, Avista received a “responsibility” because they are not responsible for discharging nutrients, but their Long Lake Dam created the lake and conditions that contribute to the reservoir’s impairment. Avista’s task is to increase dissolved oxygen in the deeper parts of Lake Spokane from July 1 through October. The level of dissolved oxygen improvement required depends on the location and depth of the lake, as well as time of the year, but the required increase ranges from 0.1 to 1.0 mg/L.

AVISTA CORPORATION

**LAKE SPOKANE DISSOLVED OXYGEN
WATER QUALITY ATTAINMENT PLAN
TEN YEAR REPORT**

WASHINGTON 401 CERTIFICATION
FERC LICENSE APPENDIX B, SECTION 5.6

Spokane River Hydroelectric Project
FERC Project No. 2545

Prepared By:



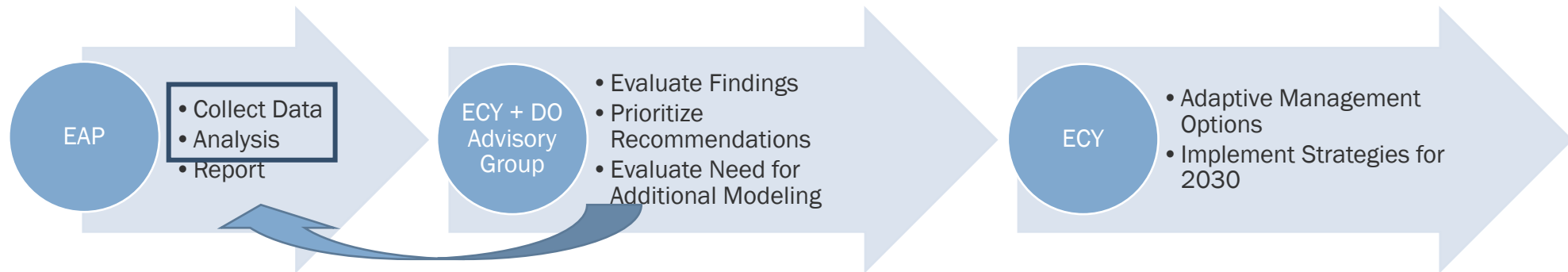
February 2022

TMDL 10-year Effectiveness Monitoring Assessment Strategy

TMDL laid out a schedule containing milestones to indicate progress toward achieving the allocations...

Ten years after approval of the TMDL (2020):

- *NPDES permittees in Washington will operate newly-installed technology to meet their allocations. If necessary, they may start, continue, or complete target pursuit actions.*
- *Avista will assess performance of the activities identified in their water quality attainment plan to improve dissolved oxygen.*
- *The riverine assessment point downstream of Nine Mile Dam, that also considers input from the Little Spokane River, will achieve a total phosphorus concentration of 10 µg/L.*



10-YEAR ASSESSMENT PROGRESS...

September 2021 – February 2023

The Purpose: To Assess Measurable Progress Towards Achieving TMDL Goals

1-Year
Ambient
Stream
Sampling
Completed



Supplemental
Stream
Monitoring
Completed



Lake Sampling &
Vertical Profiling
Completed



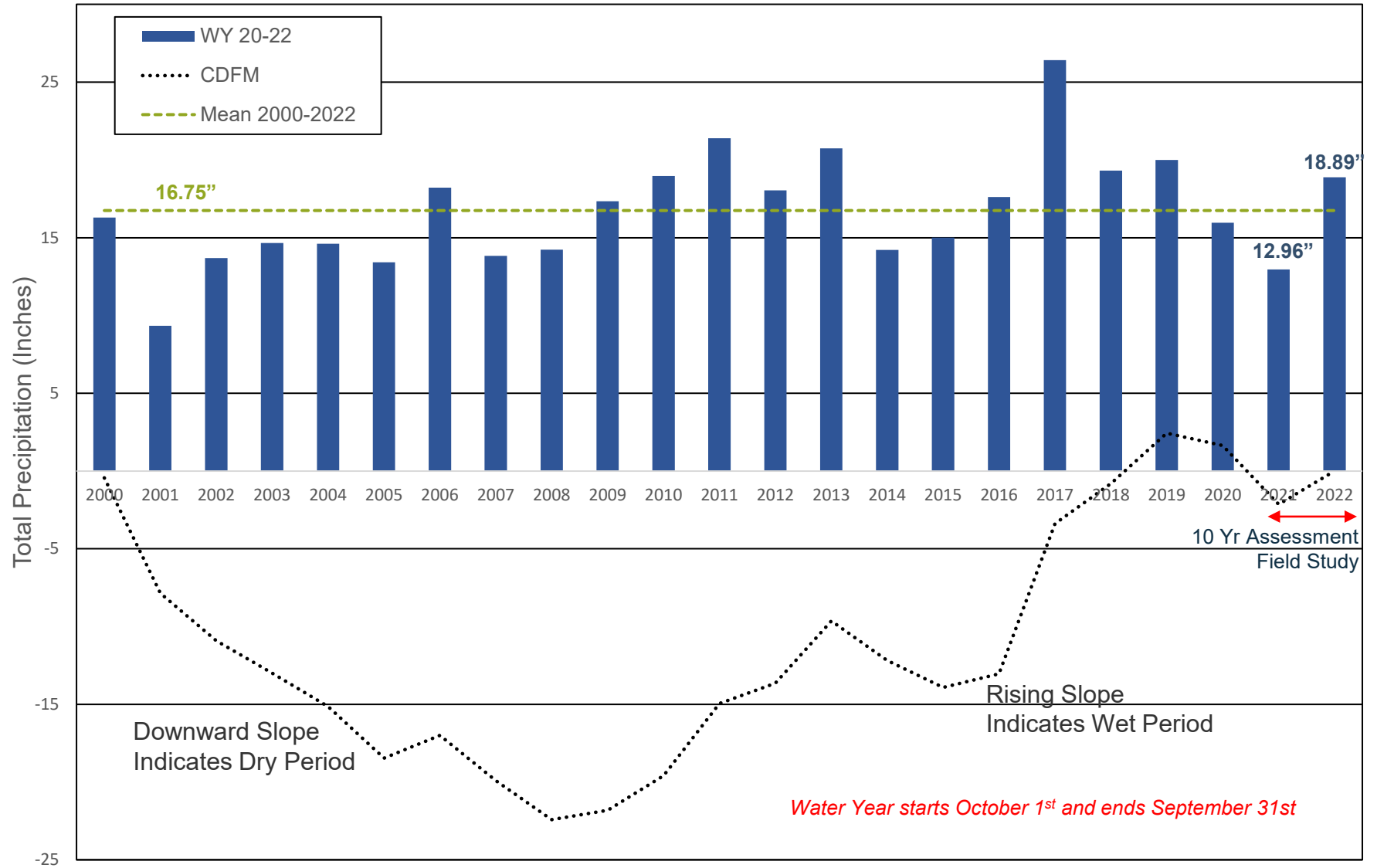
Hydrology Overview

Historic Precipitation



Annual Precipitation Totals and Cumulative Departure From Mean Water Years 2000-2022

(Source: PRISM Annual Data Sets 2000-2022)



PRISM Climate Group, Oregon State University, <https://prism.oregonstate.edu>



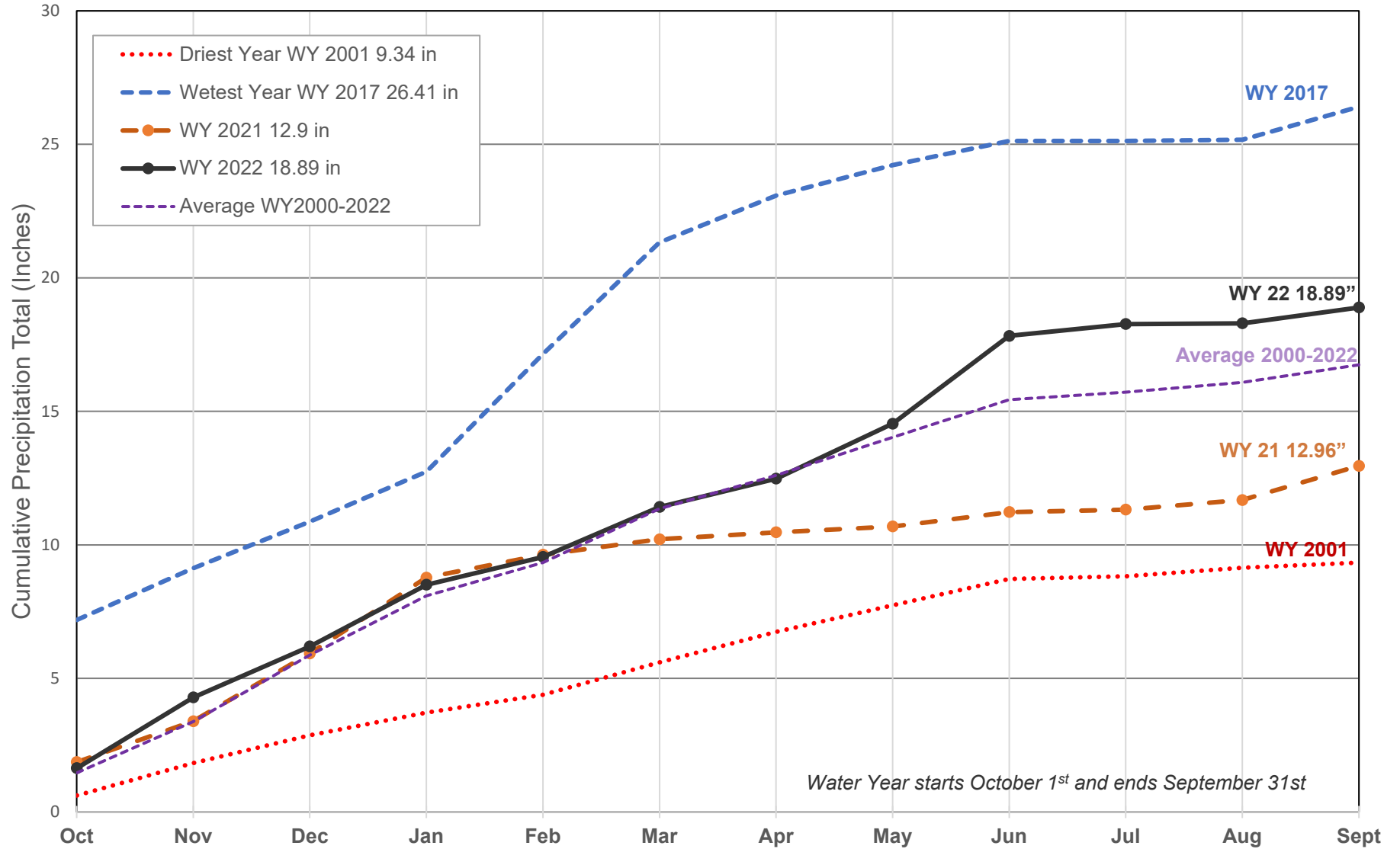
Hydrology Overview

Water Year Precipitation Comparison



Cumulative Precipitation Totals Comparison Chart

(Source: PRISM Annual Data Sets 2000-2022)

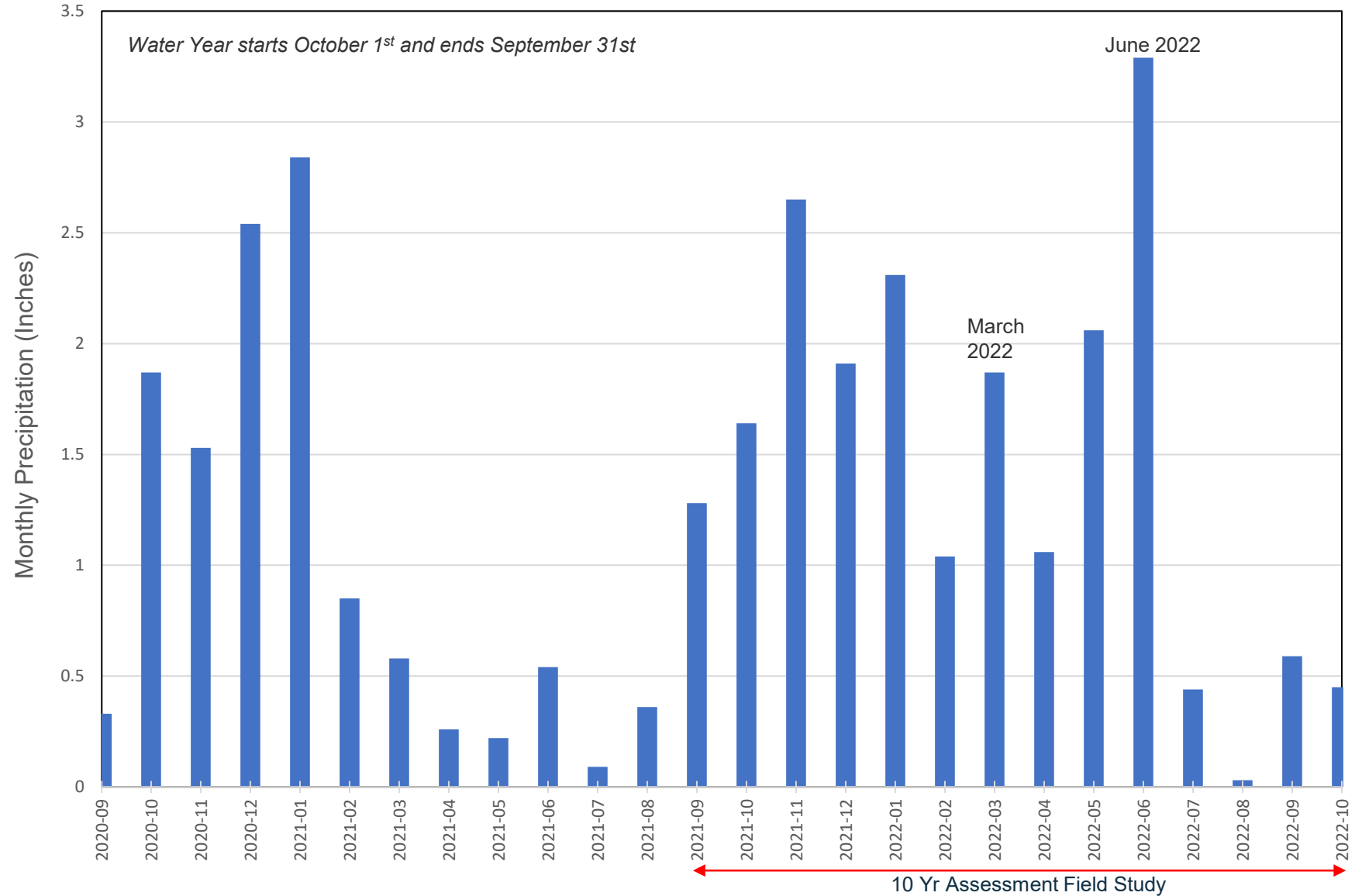


Hydrology Overview

Monthly Precipitation Review



Monthly Precipitation Totals WY 2021-2022



PRISM Climate Group, Oregon State University, <https://prism.oregonstate.edu>

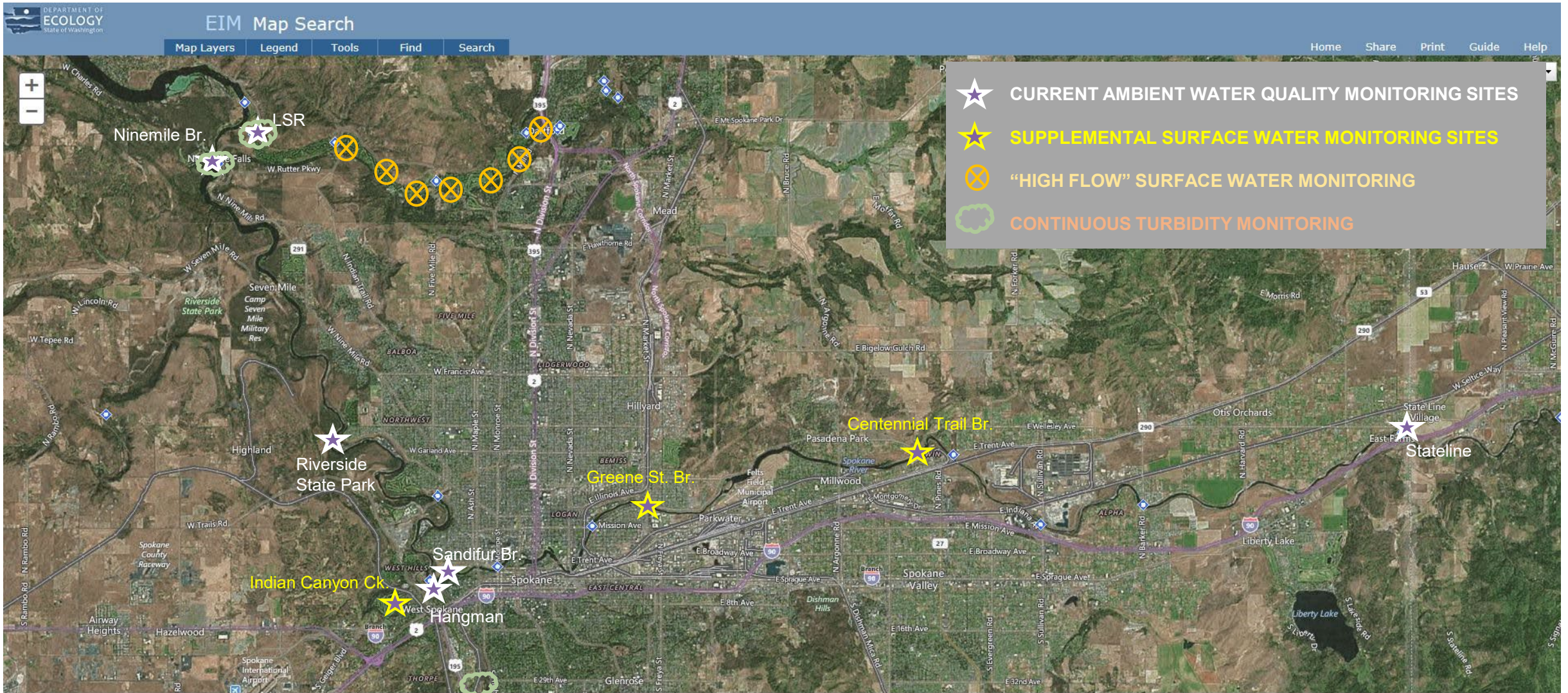
Hydrology Overview

Spokane River Stream Flow



Spokane River at Spokane, WA

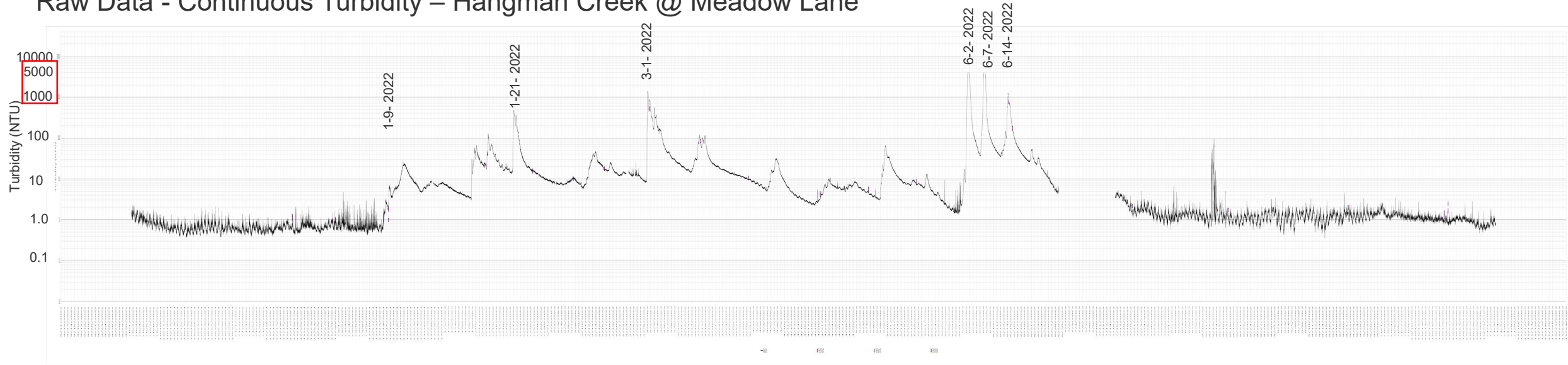
10-YEAR ASSESSMENT STREAM MONITORING LOCATIONS



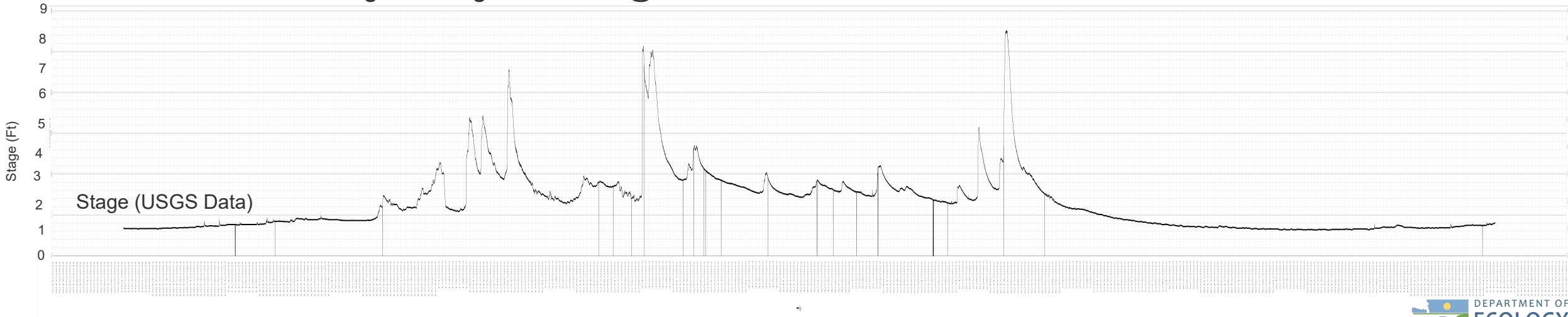
Preliminary Data

Continuous Monitoring Data (9/2021 - 10/2022)

Raw Data - Continuous Turbidity – Hangman Creek @ Meadow Lane



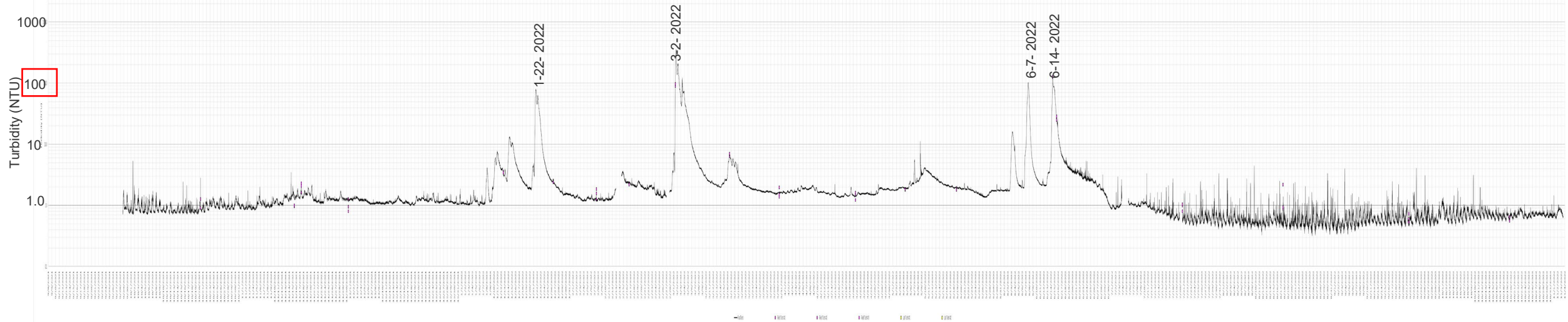
Raw Data - Continuous Stage – Hangman Creek @ Mouth



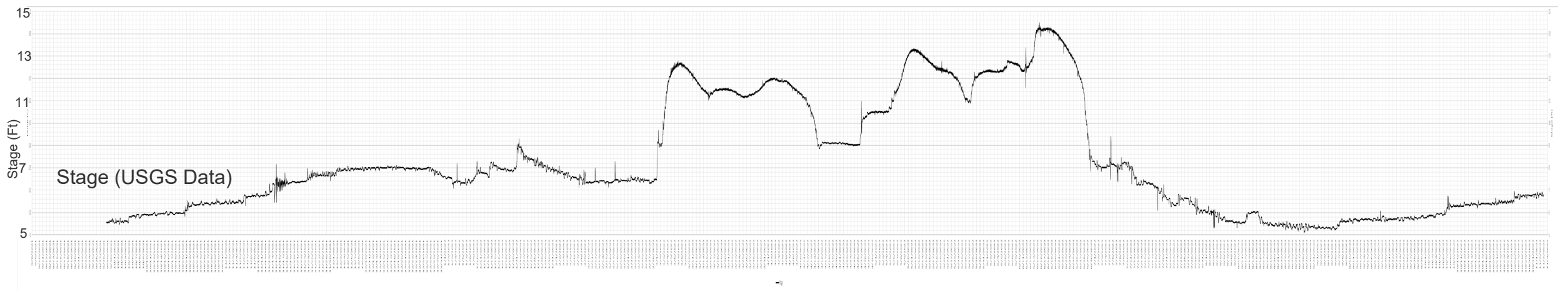
Preliminary Data

Continuous Monitoring Data (9/2021 – 10/2022)

Raw Data - Continuous Turbidity – Spokane River @ Spokane House



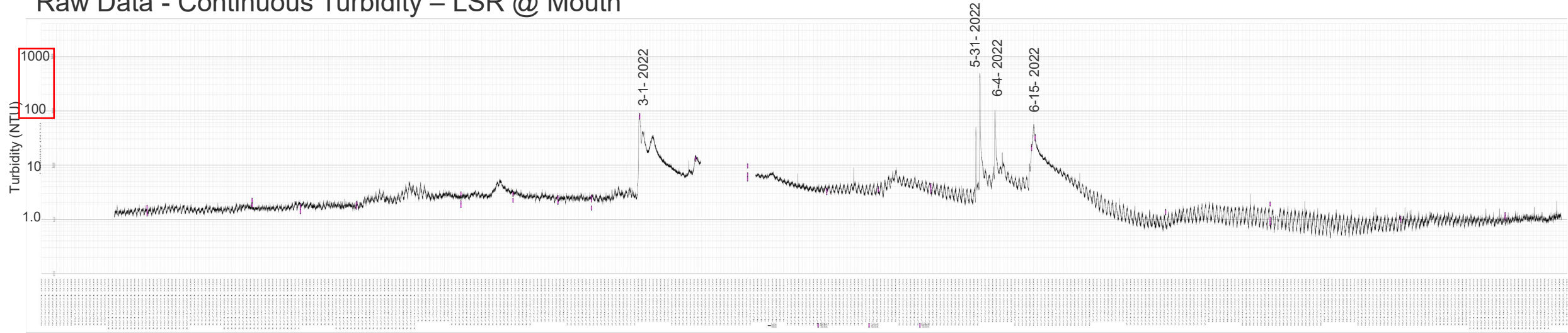
Raw Data - Continuous Stage – Spokane River @ Spokane House



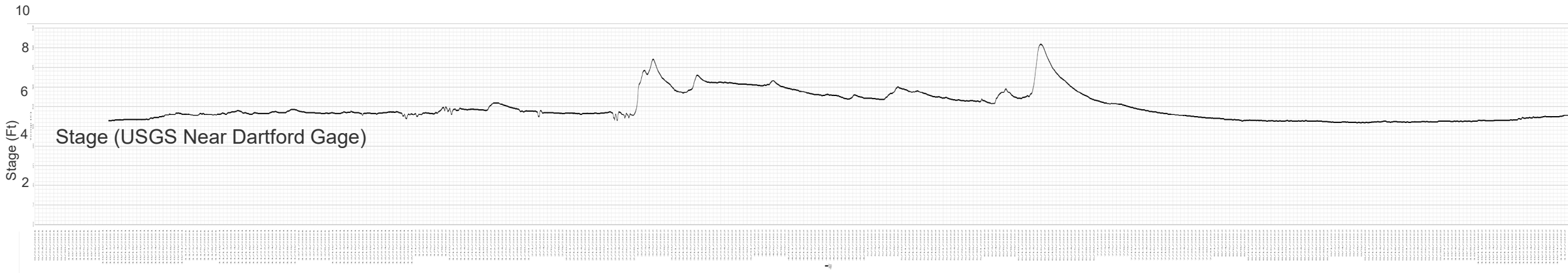
Preliminary Data

Continuous Monitoring Data (9/2021 – 10/2022)

Raw Data - Continuous Turbidity – LSR @ Mouth

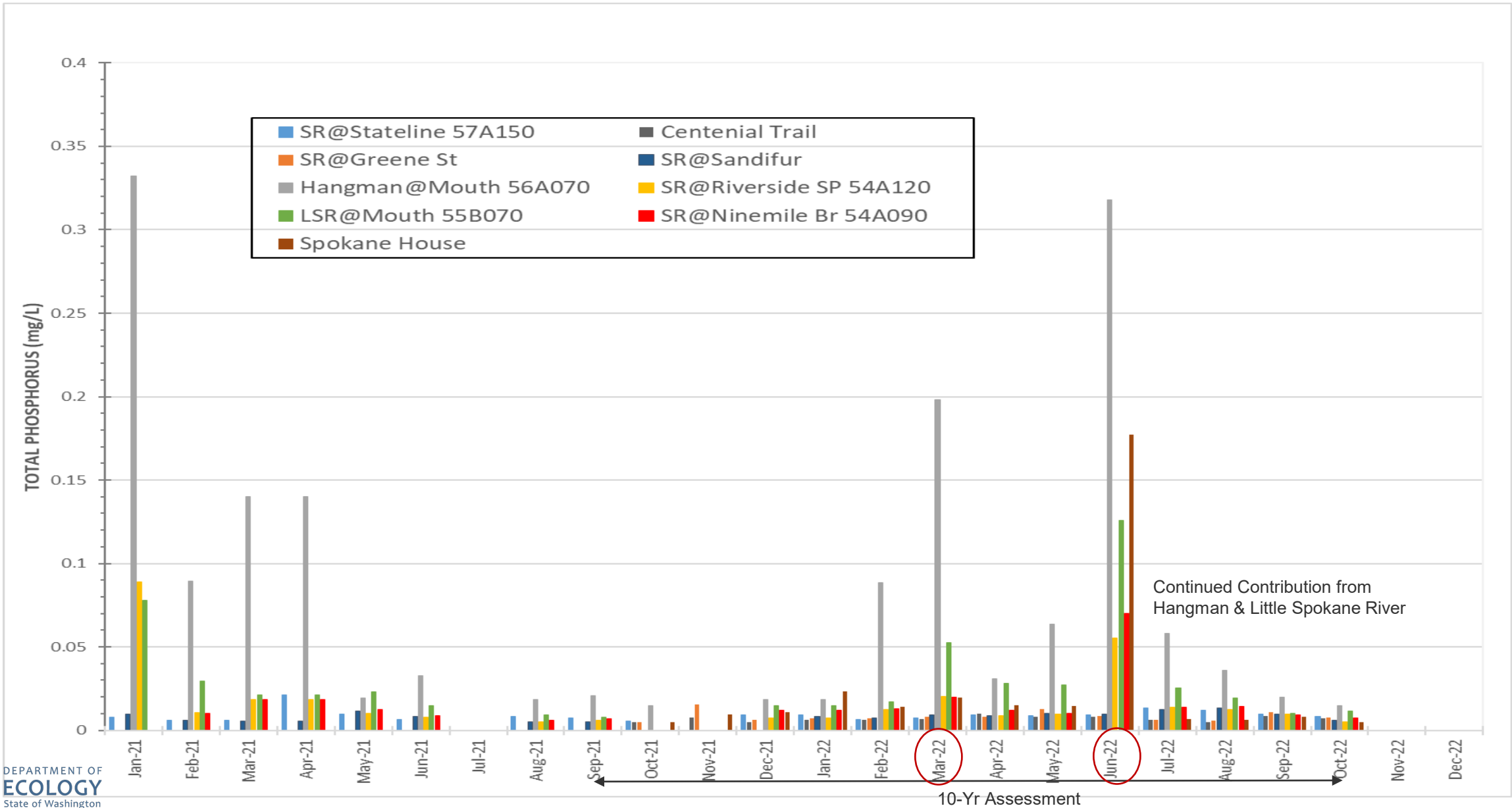


Raw Data - Continuous Stage – LSR @ Near Dartford



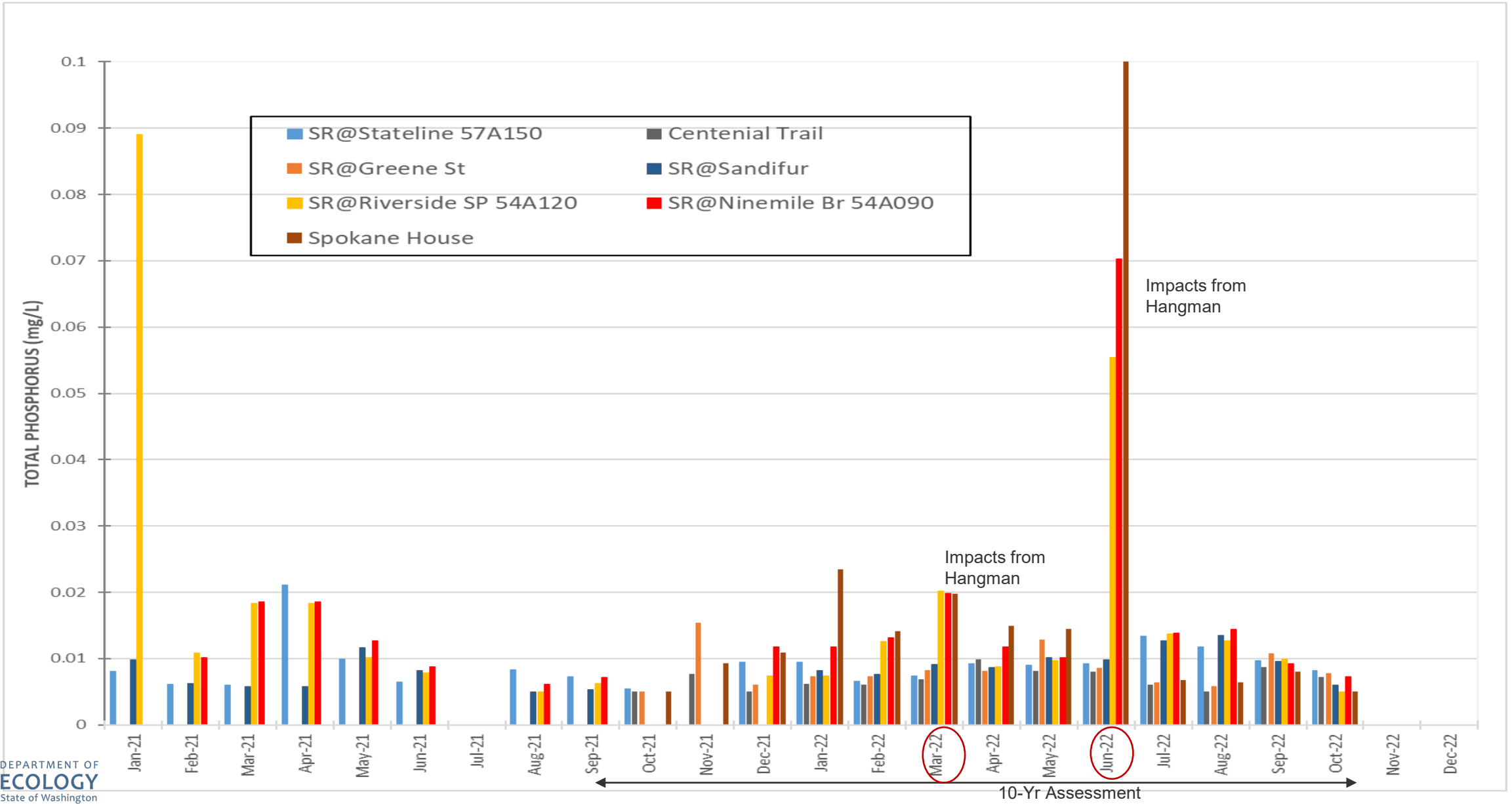
Preliminary Data

Total Phosphorus – 10-Yr Assessment Monitoring Stations (2021-2022)



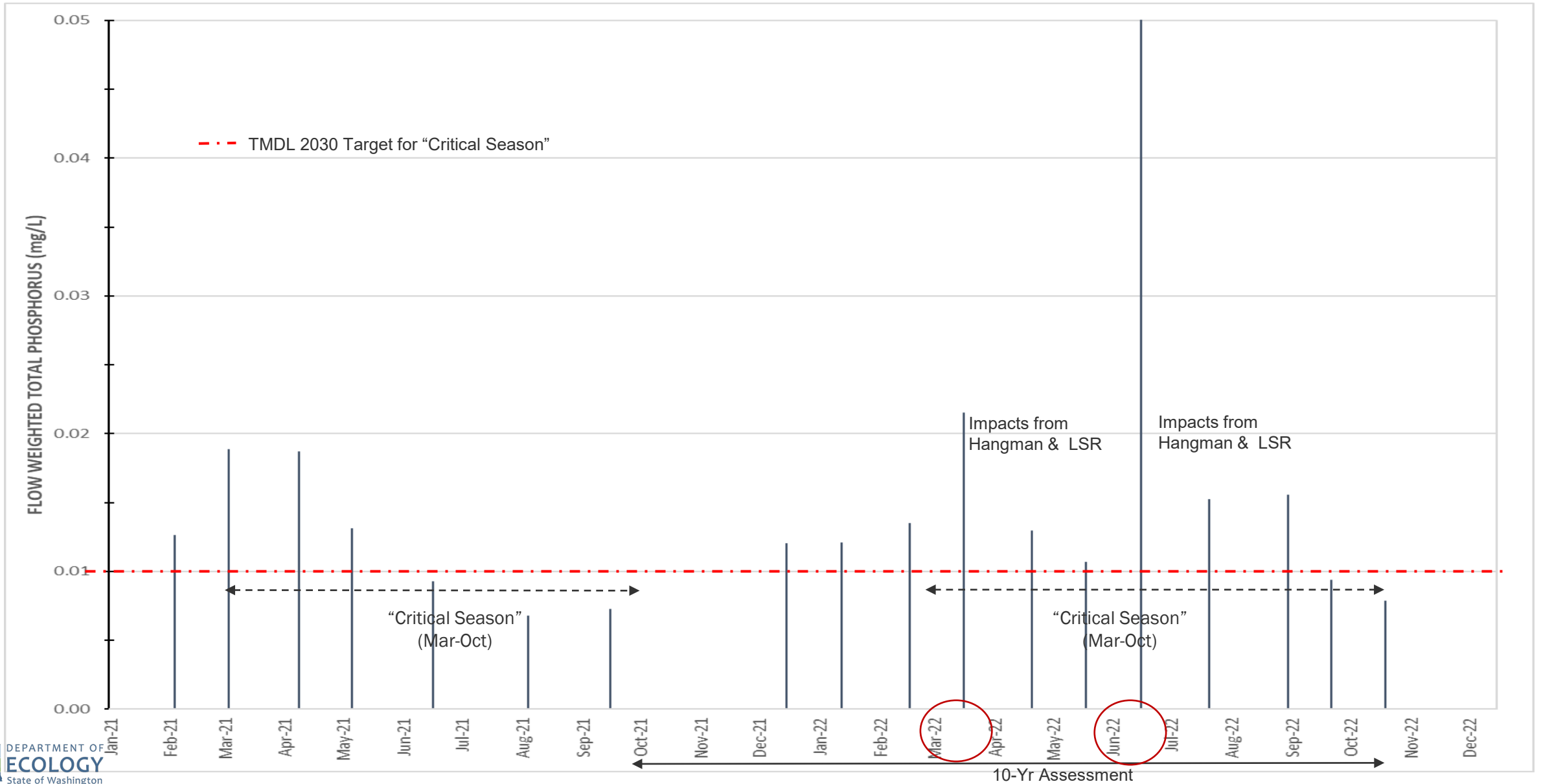
Preliminary Data

Total Phosphorus – 10-Yr Assessment Monitoring Stations (2021-2022) (excluding Hangman Creek and Little Spokane River)



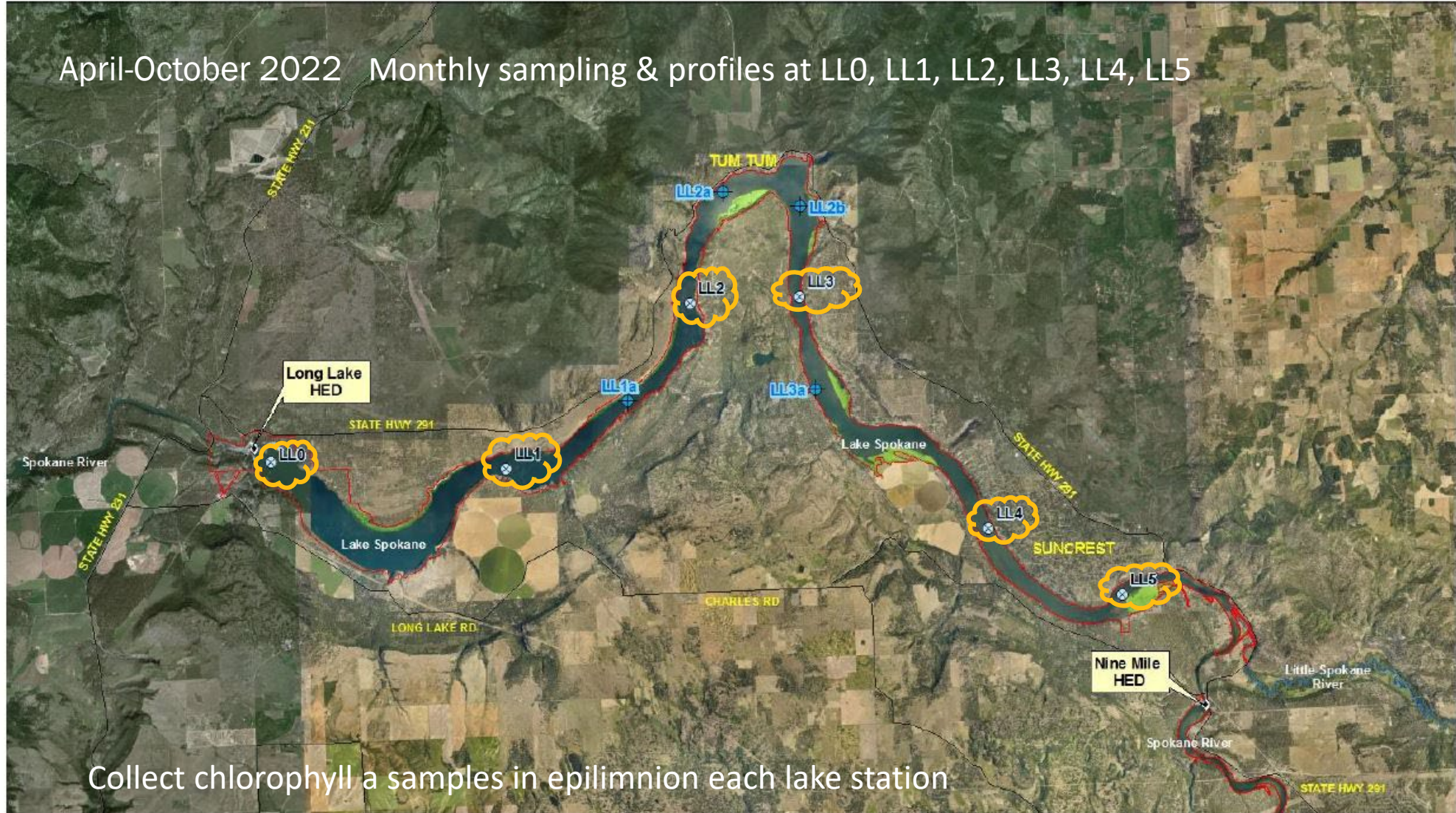
Preliminary Data

Flow Weighted Average Phosphorus (2021-2022) (Combined Spokane River @ Ninemile with Little Spokane River @ Mouth)



LAKE SPOKANE MONITORING LOCATIONS

April-October 2022 Monthly sampling & profiles at LL0, LL1, LL2, LL3, LL4, LL5



Collect chlorophyll a samples in epilimnion each lake station

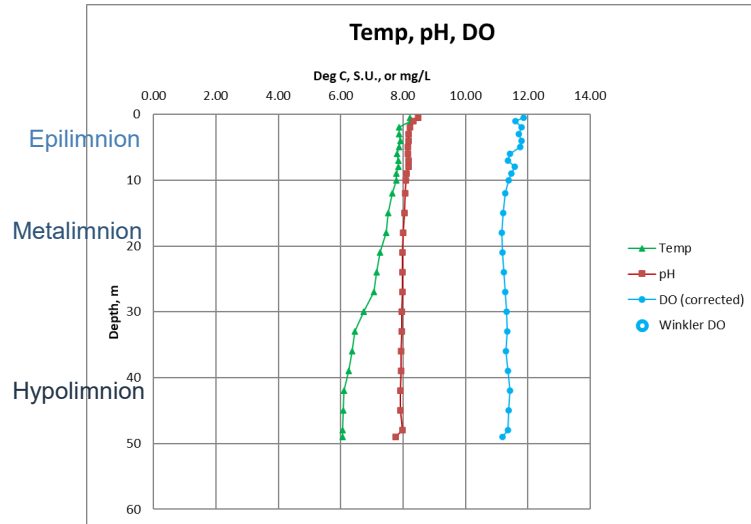
Figure 2. Location of Lake Spokane baseline monitoring stations and the four supplemental monitoring stations

Source: Avista DOWQAP 2019 Annual Summary 8-Yr Report

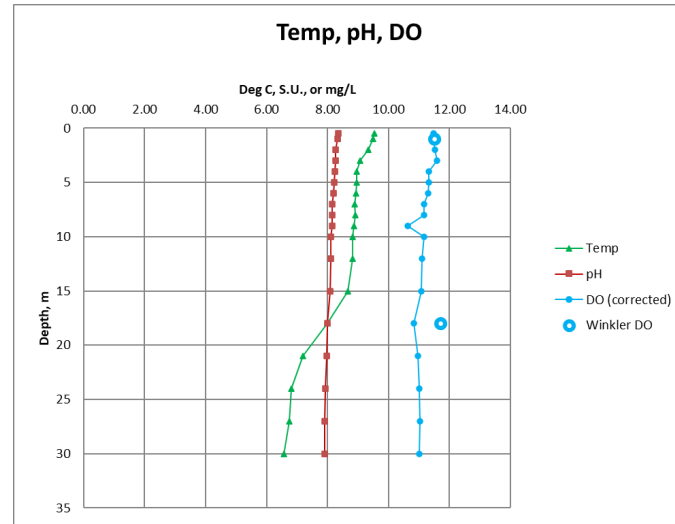
Preliminary Data

Lake Spokane Profile Data 4-27-2022

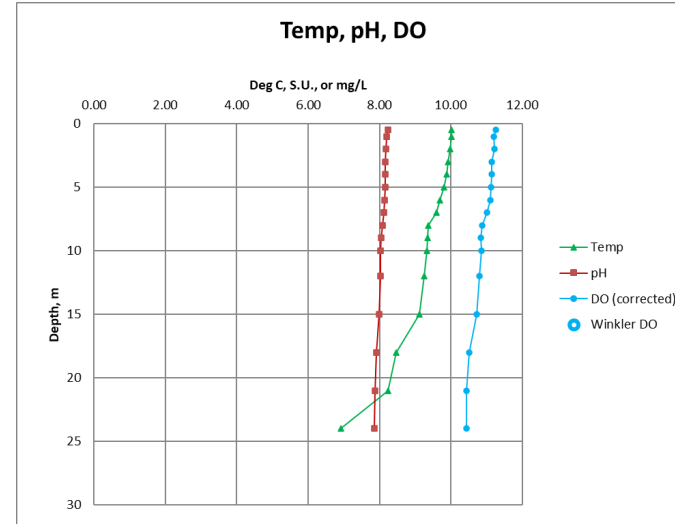
LL0 Near dam



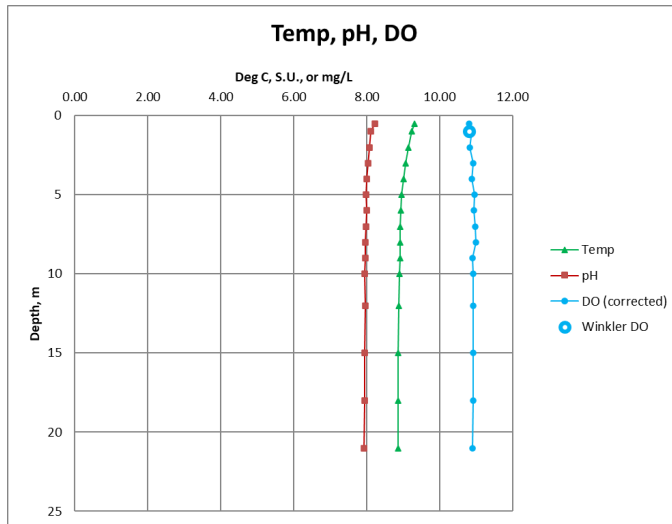
LL1



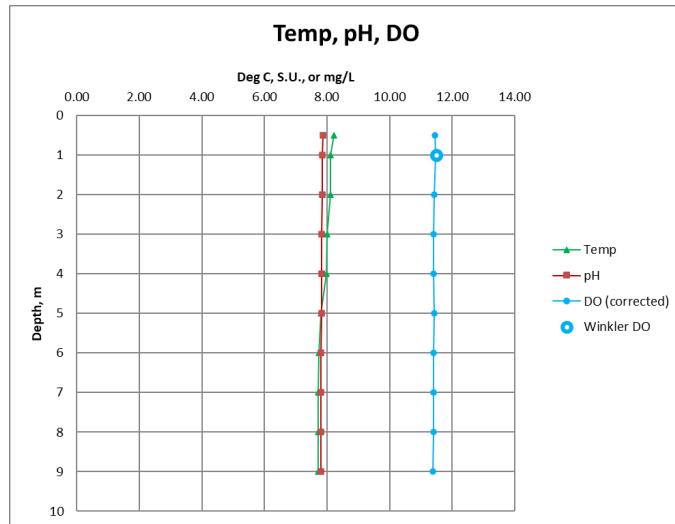
LL2 Below Tum Tum



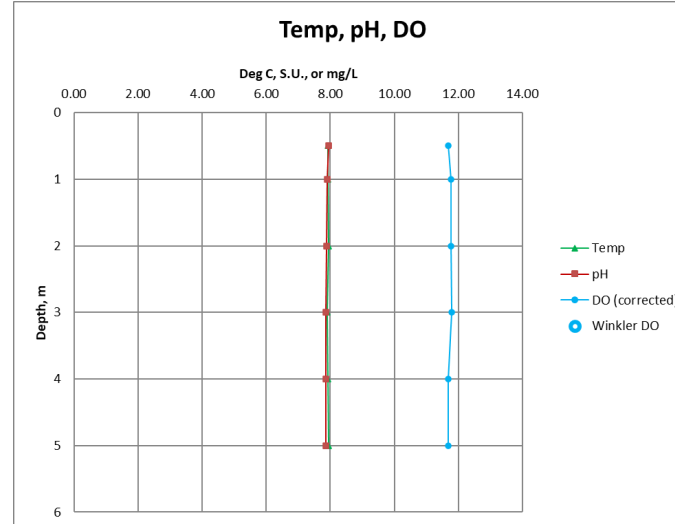
LL3 Above Tum Tum



LL4 Near Suncrest



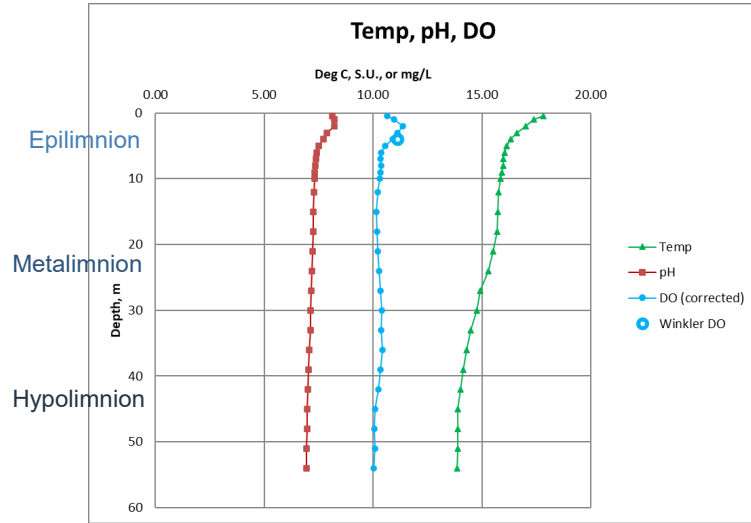
LL5



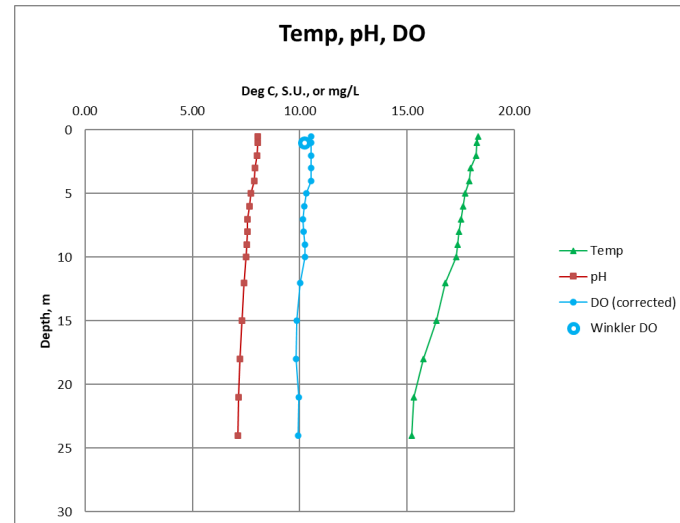
Preliminary Data

Lake Spokane Profile Data 6-29-2022

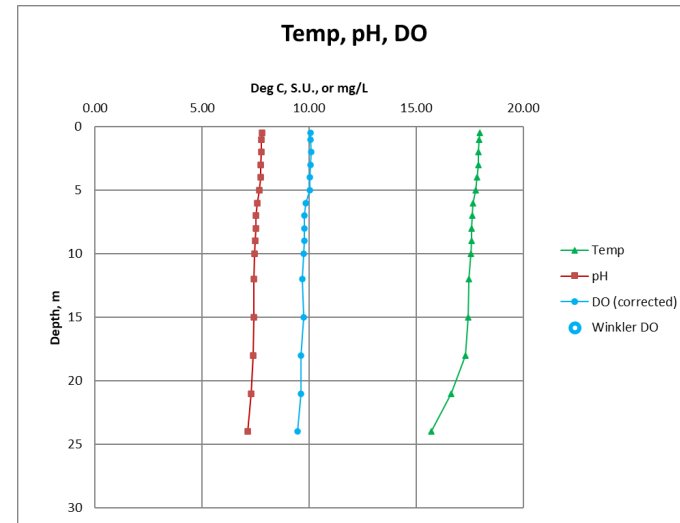
LL0 Near dam



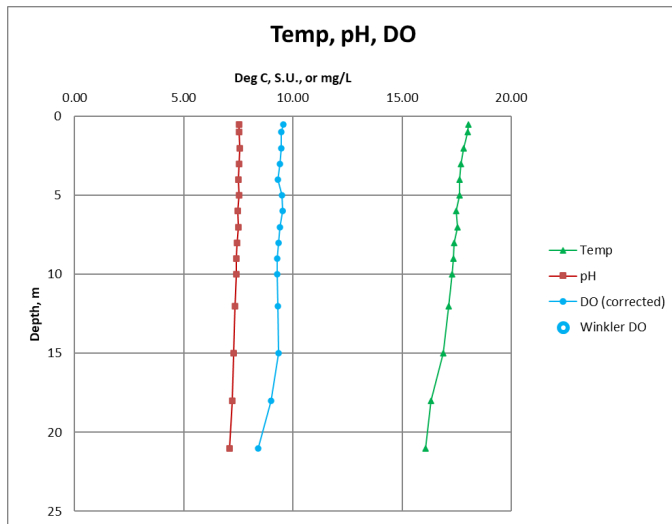
LL1



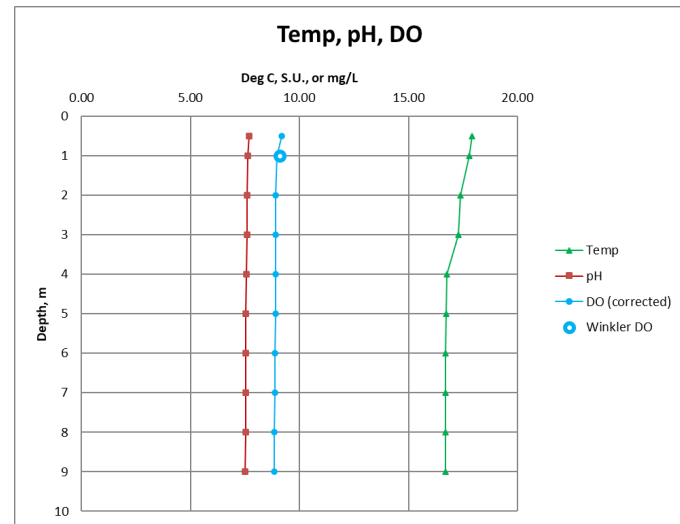
LL2 Below Tum Tum



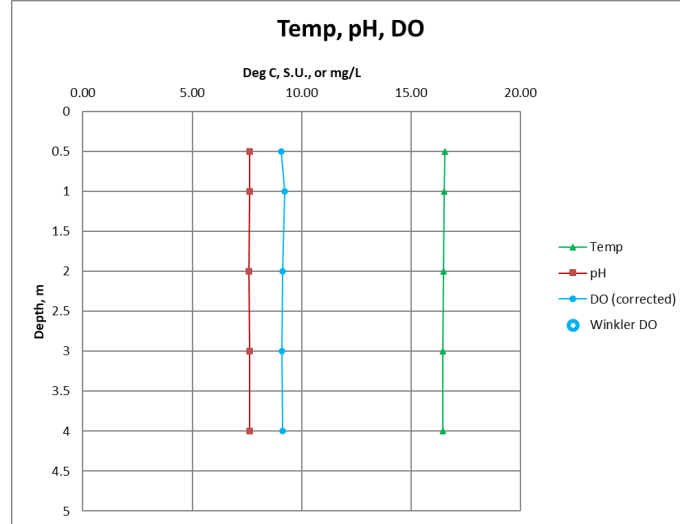
LL3 Above Tum Tum



LL4 Near Suncrest



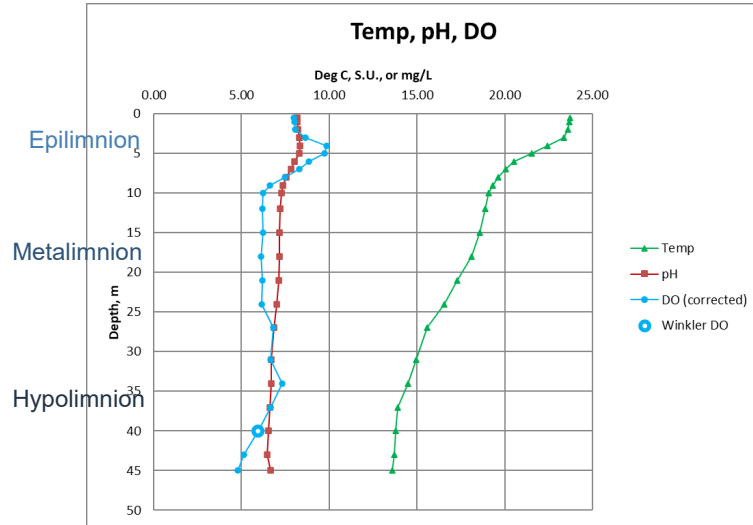
LL5



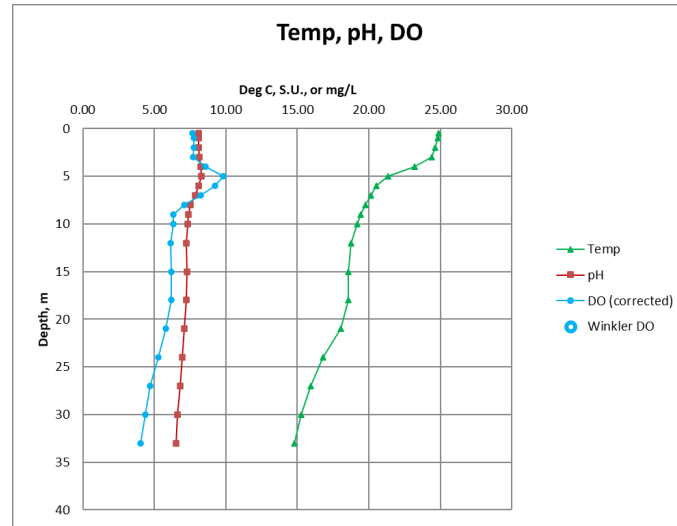
Preliminary Data

Lake Spokane Profile Data 7-26-2022

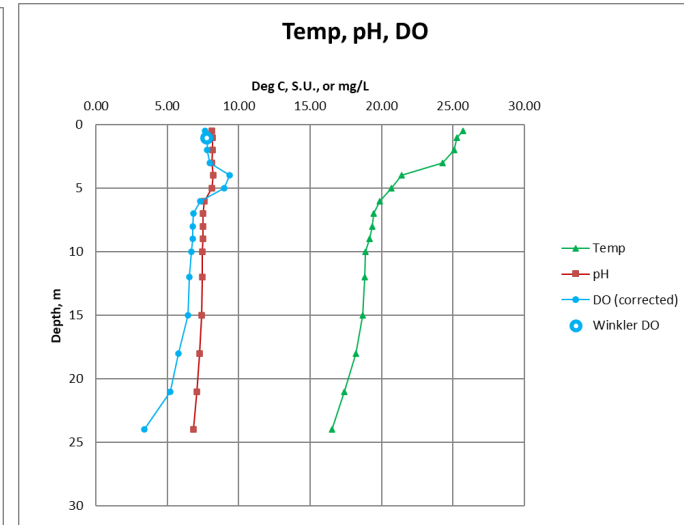
LL0 Near dam



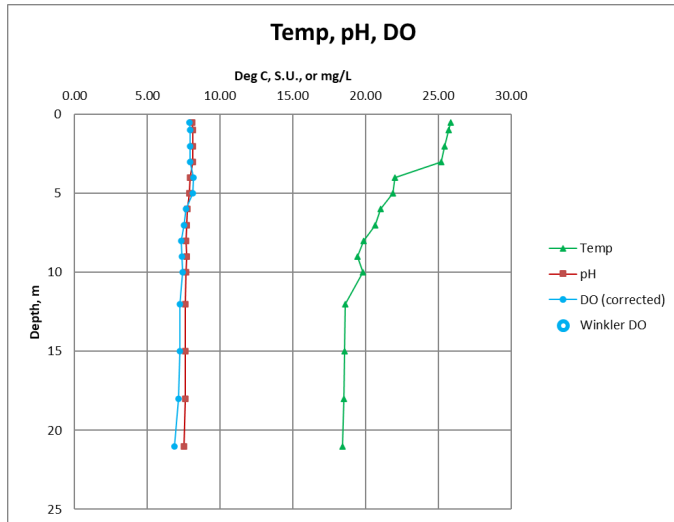
LL1



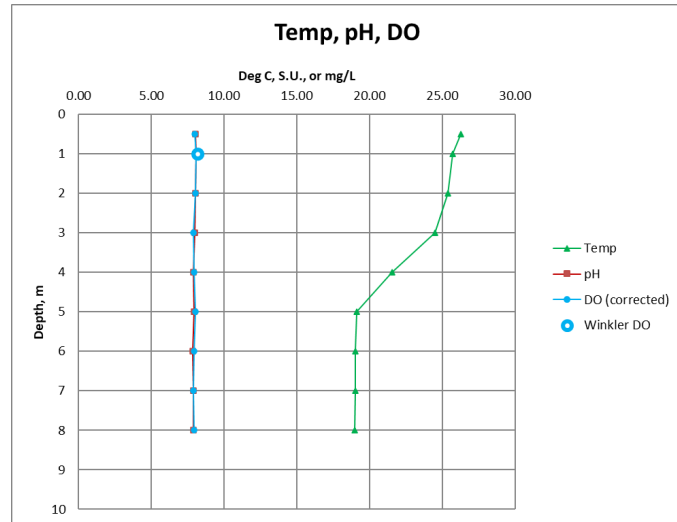
LL2 Below Tum Tum



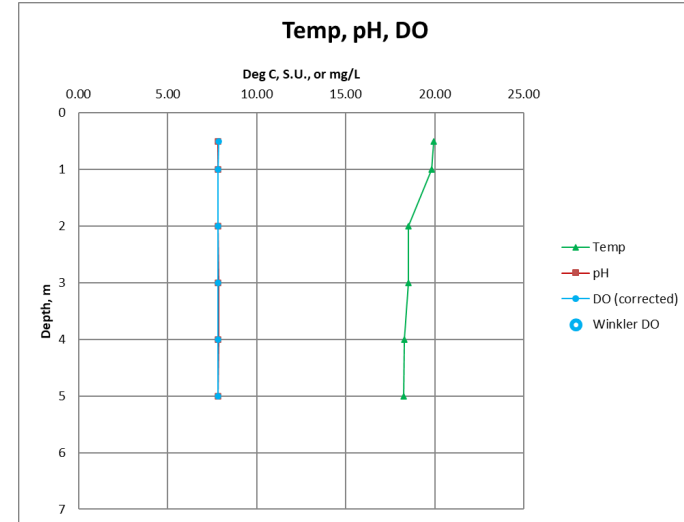
LL3 Above Tum Tum



LL4 Near Suncrest



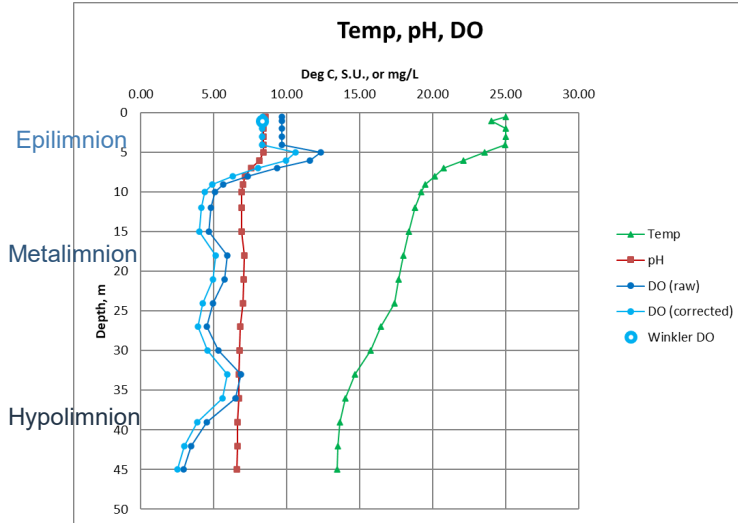
LL5



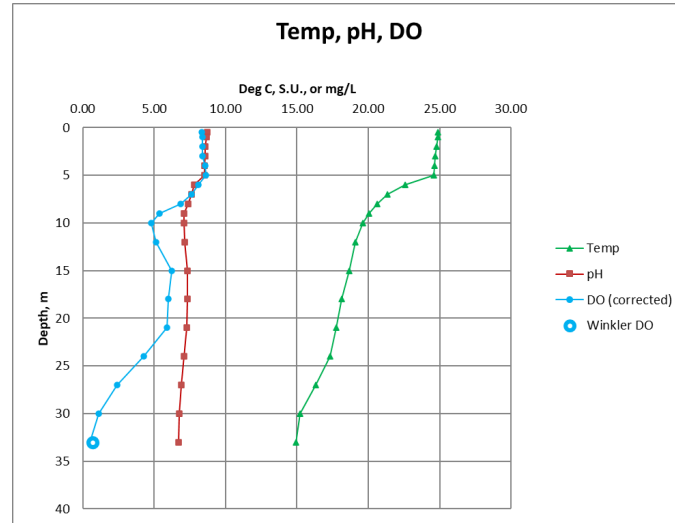
Preliminary Data

Lake Spokane Profile Data 8-23-2022

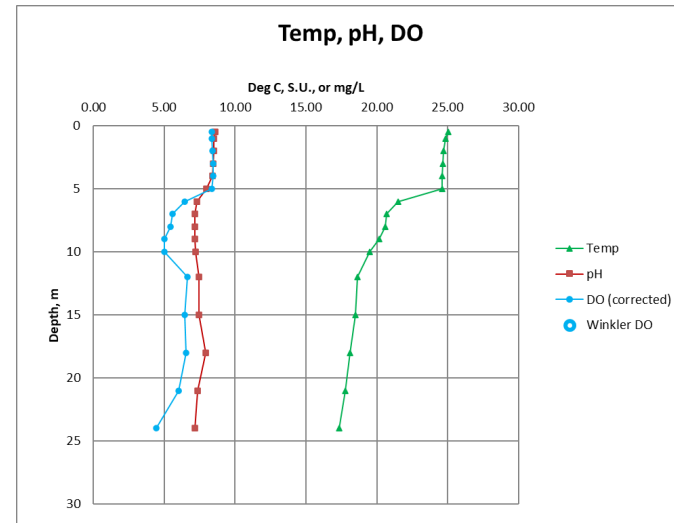
LL0 Near dam



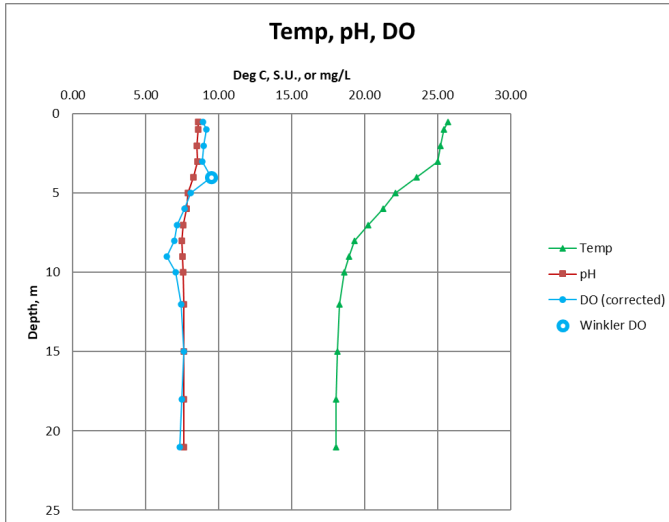
LL1



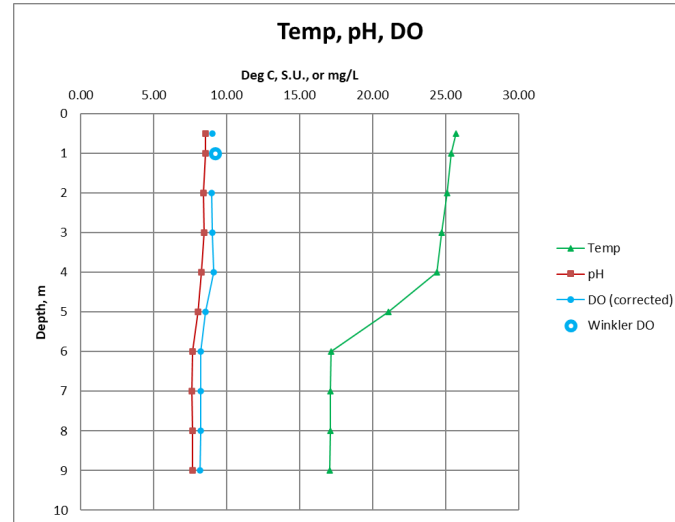
LL2 Below Tum Tum



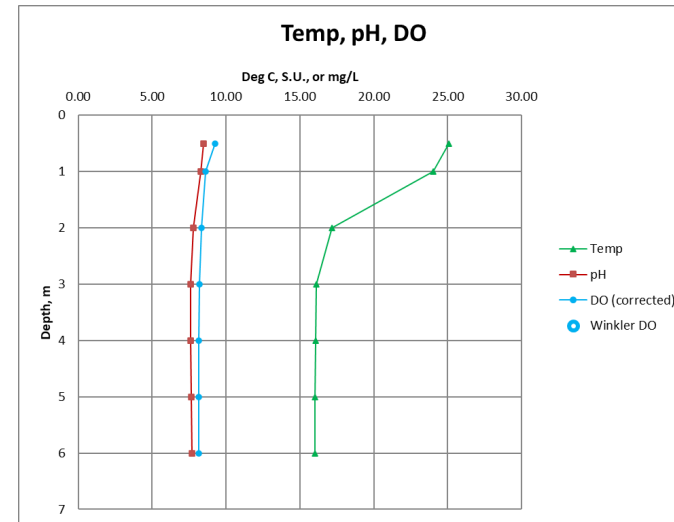
LL3 Above Tum Tum



LL4 Near Suncrest



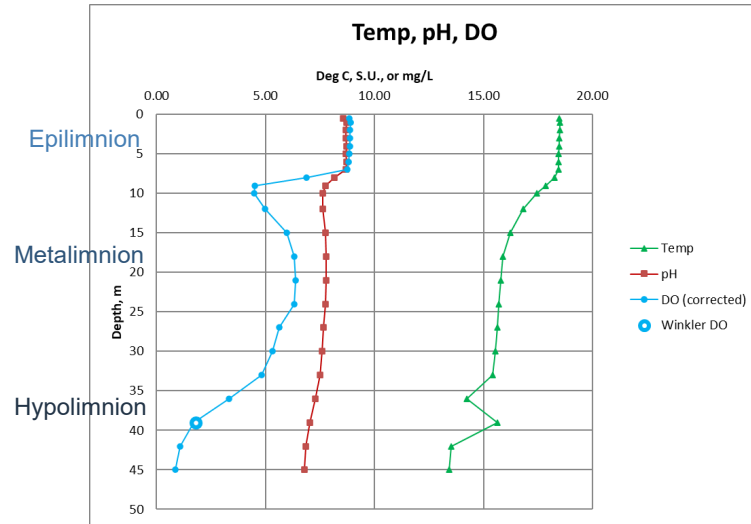
LL5



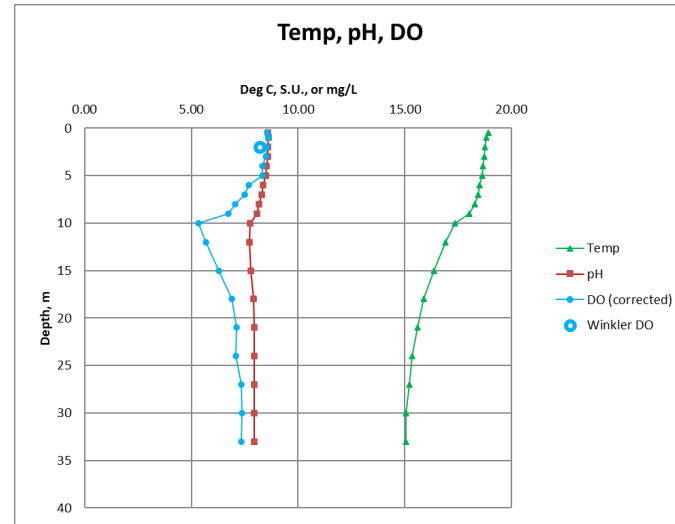
Preliminary Data

Lake Spokane Profile Data 9-27-2022

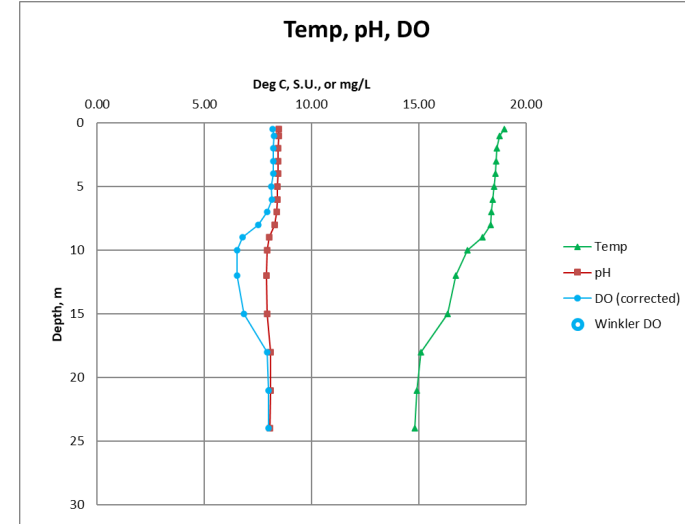
LL0 Near dam



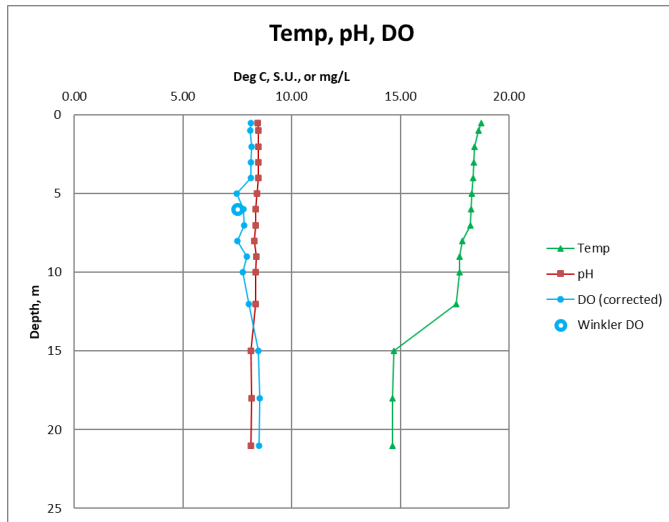
LL1



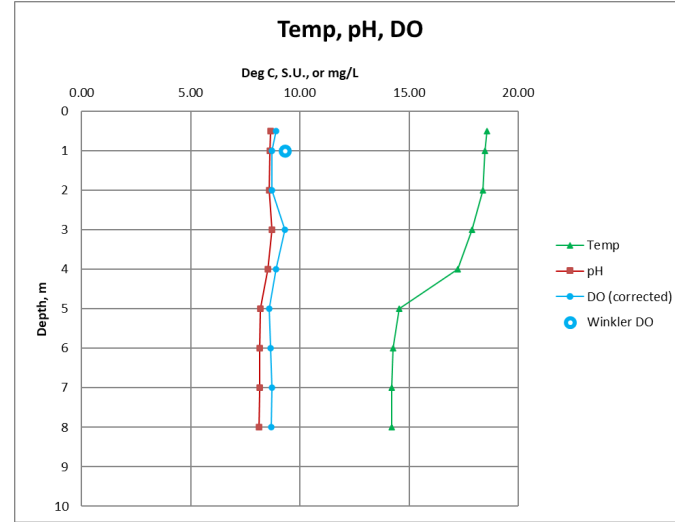
LL2 Below Tum Tum



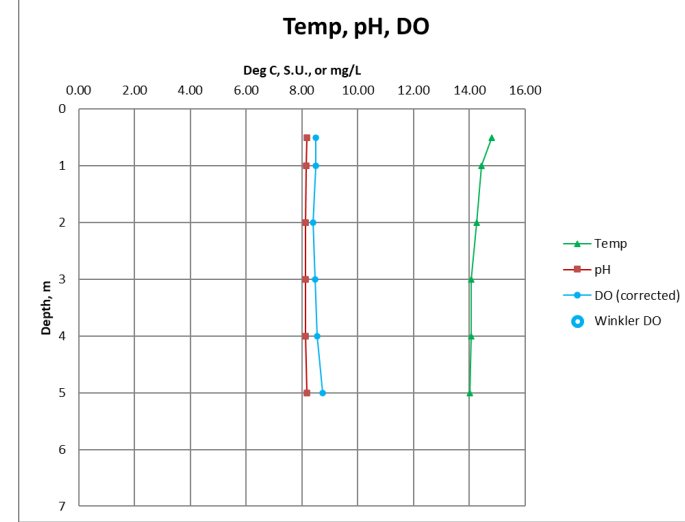
LL3 Above Tum Tum



LL4 Near Suncrest



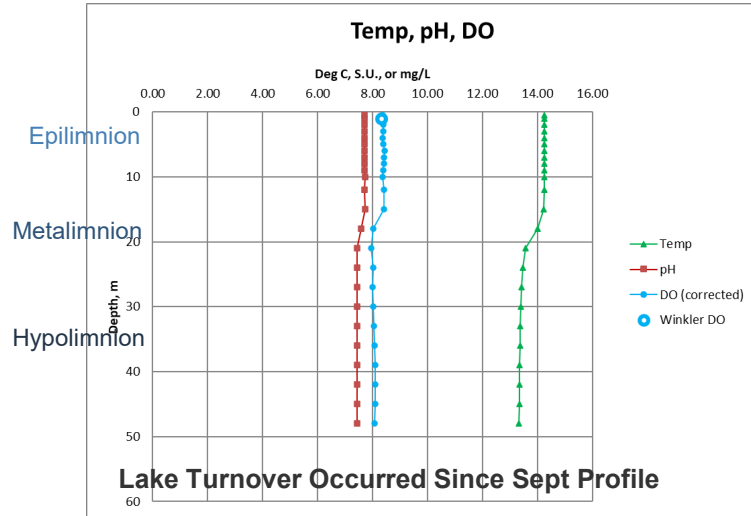
LL5



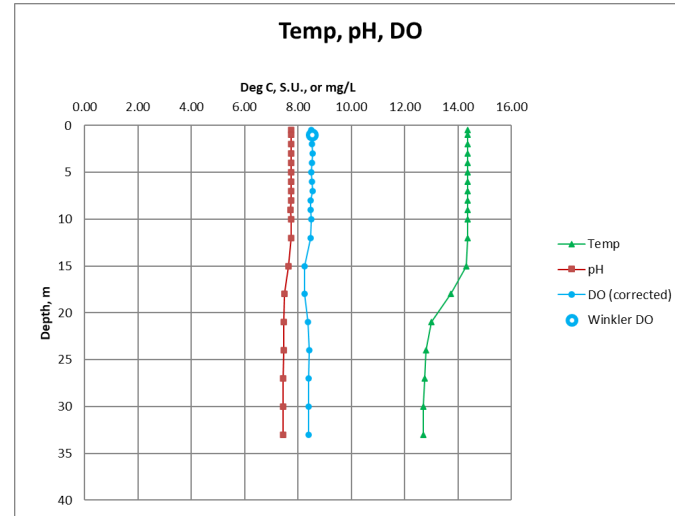
Preliminary Data

Lake Spokane Profile Data 10-25-2022

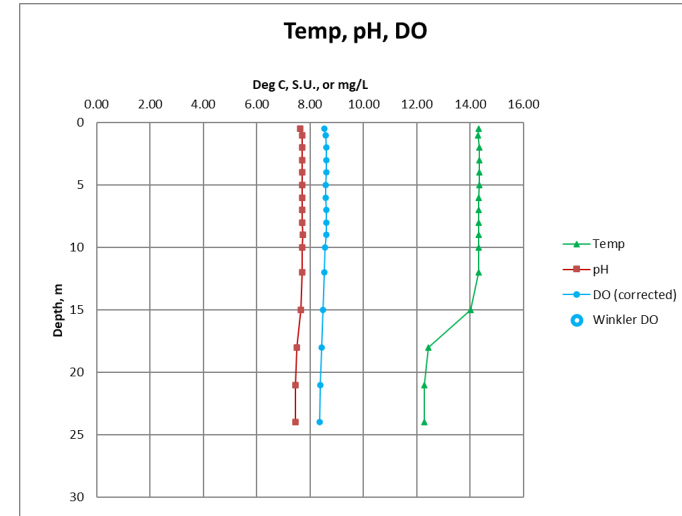
LL0 Near dam



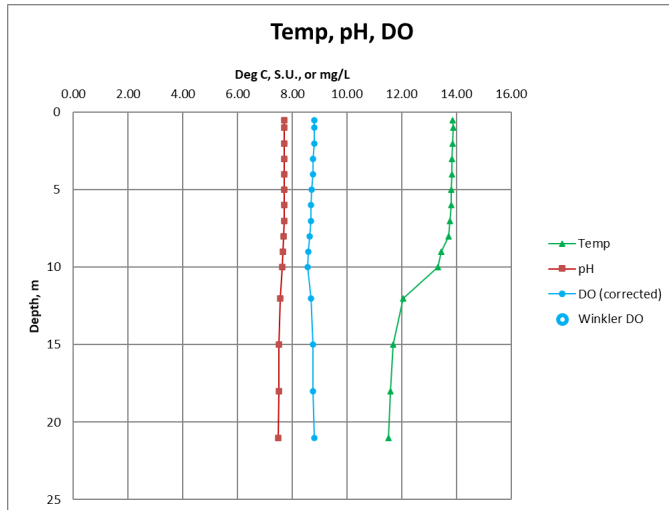
LL1



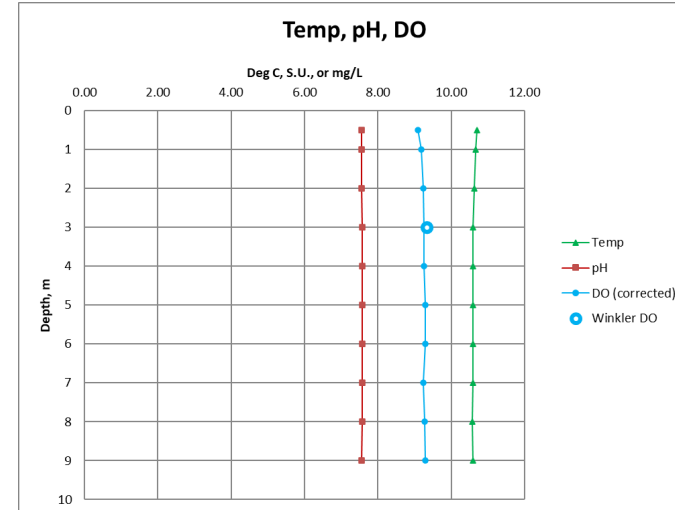
LL2 Below Tum Tum



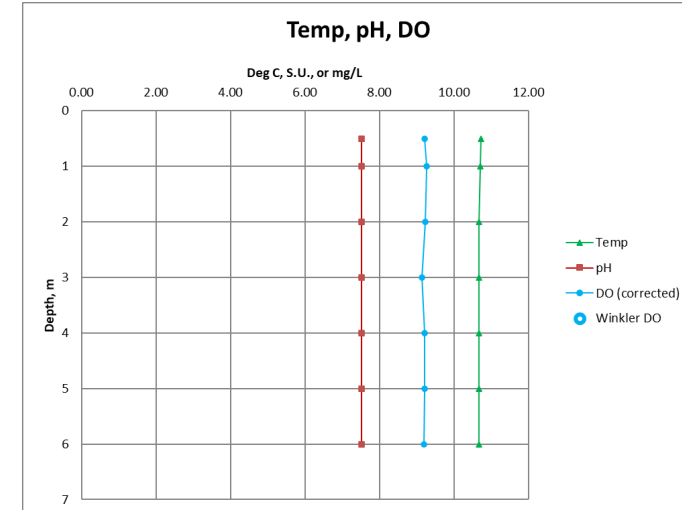
LL3 Above Tum Tum



LL4 Near Suncrest



LL5

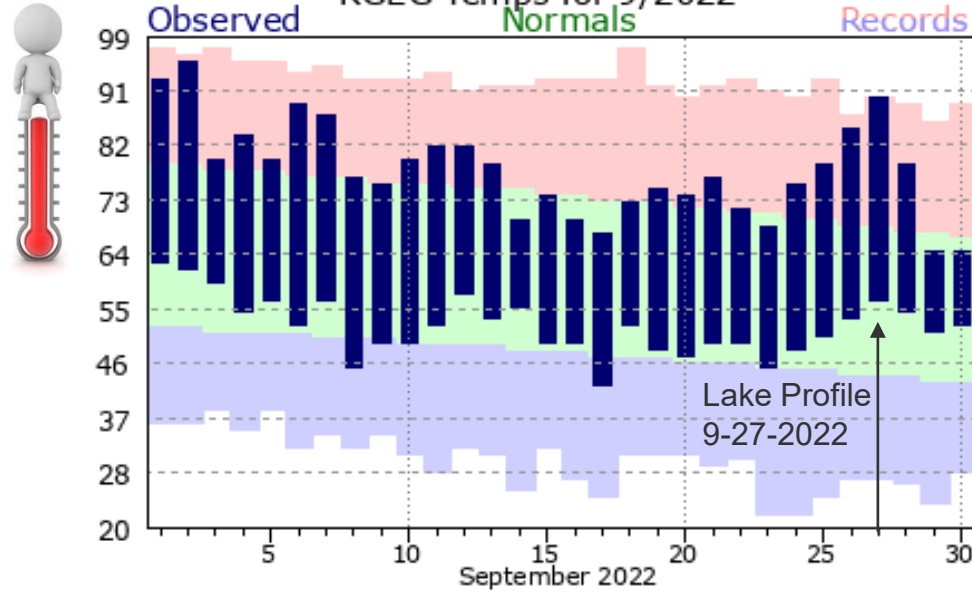


Lake Turnover Assessment



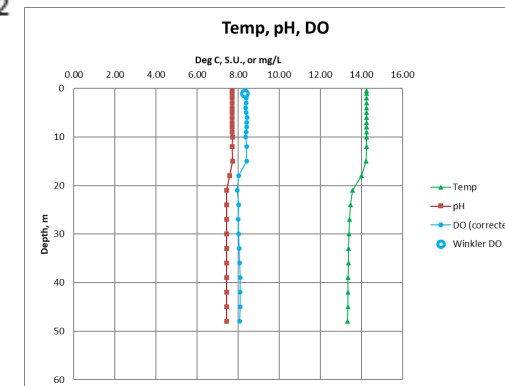
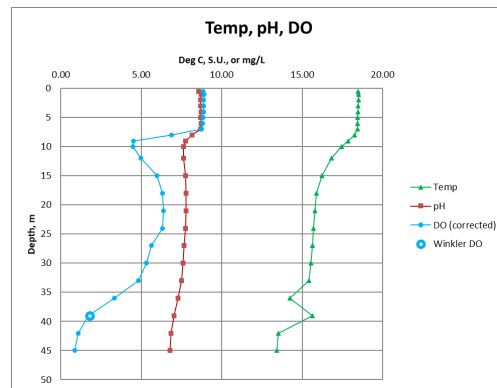
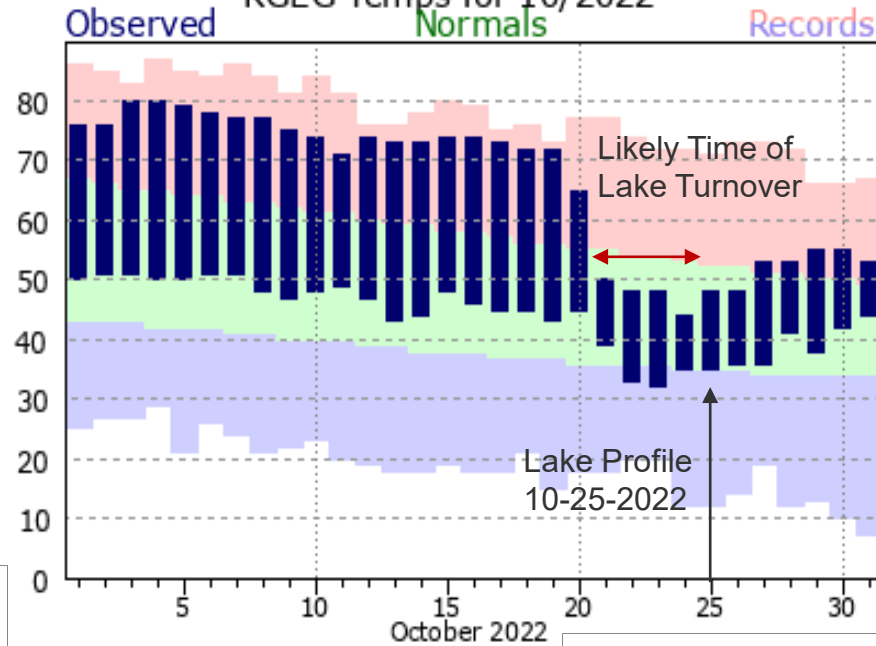
KGEK September, 2022											
Date	Observed Low (F)	Observed High (F)	Normal Low (F)	Normal High (F)	Record Low (F)	Year High (F)	Record High (F)	Year Low (F)	Observed Precipitation (inches)	Record Precipitation (inches)	

KGEK Temps for 9/2022



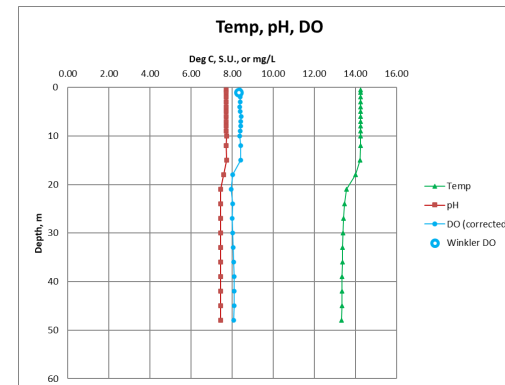
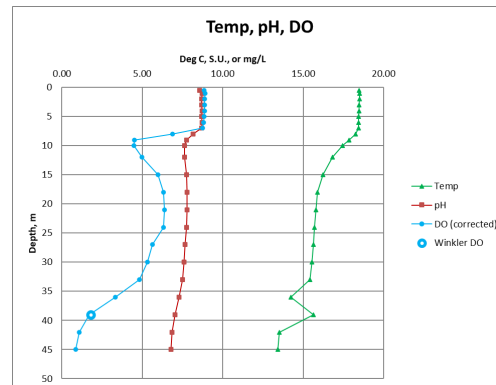
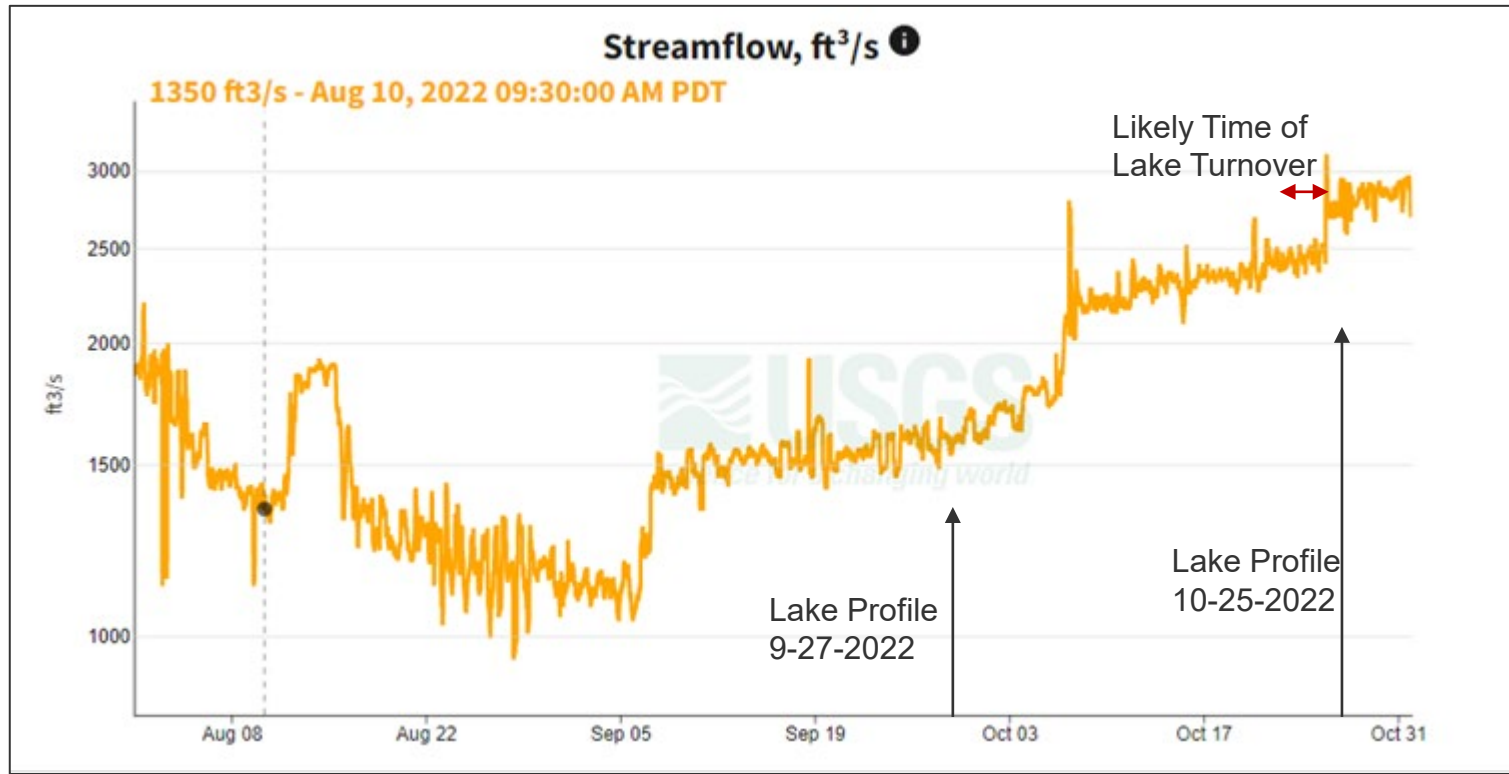
KGEK October, 2022											
Date	Observed Low (F)	Observed High (F)	Normal Low (F)	Normal High (F)	Record Low (F)	Year High (F)	Record High (F)	Year Low (F)	Observed Precipitation (inches)	Record Precipitation (inches)	

KGEK Temps for 10/2022

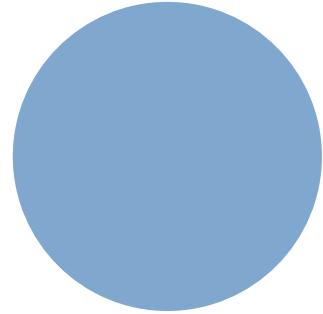


Lake Turnover Assessment

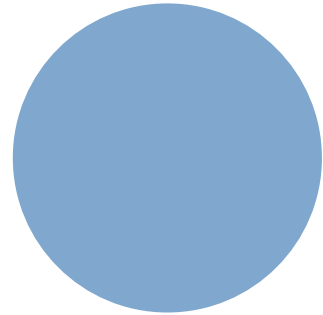
Streamflow Spokane River @ Nine Mile Dam



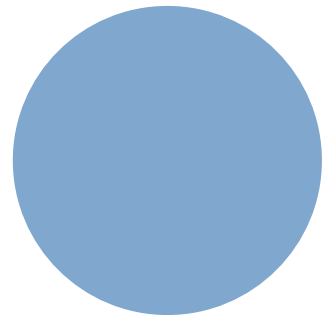
Preliminary Findings



Spokane River Water Quality



Spokane River Tributaries Water Quality

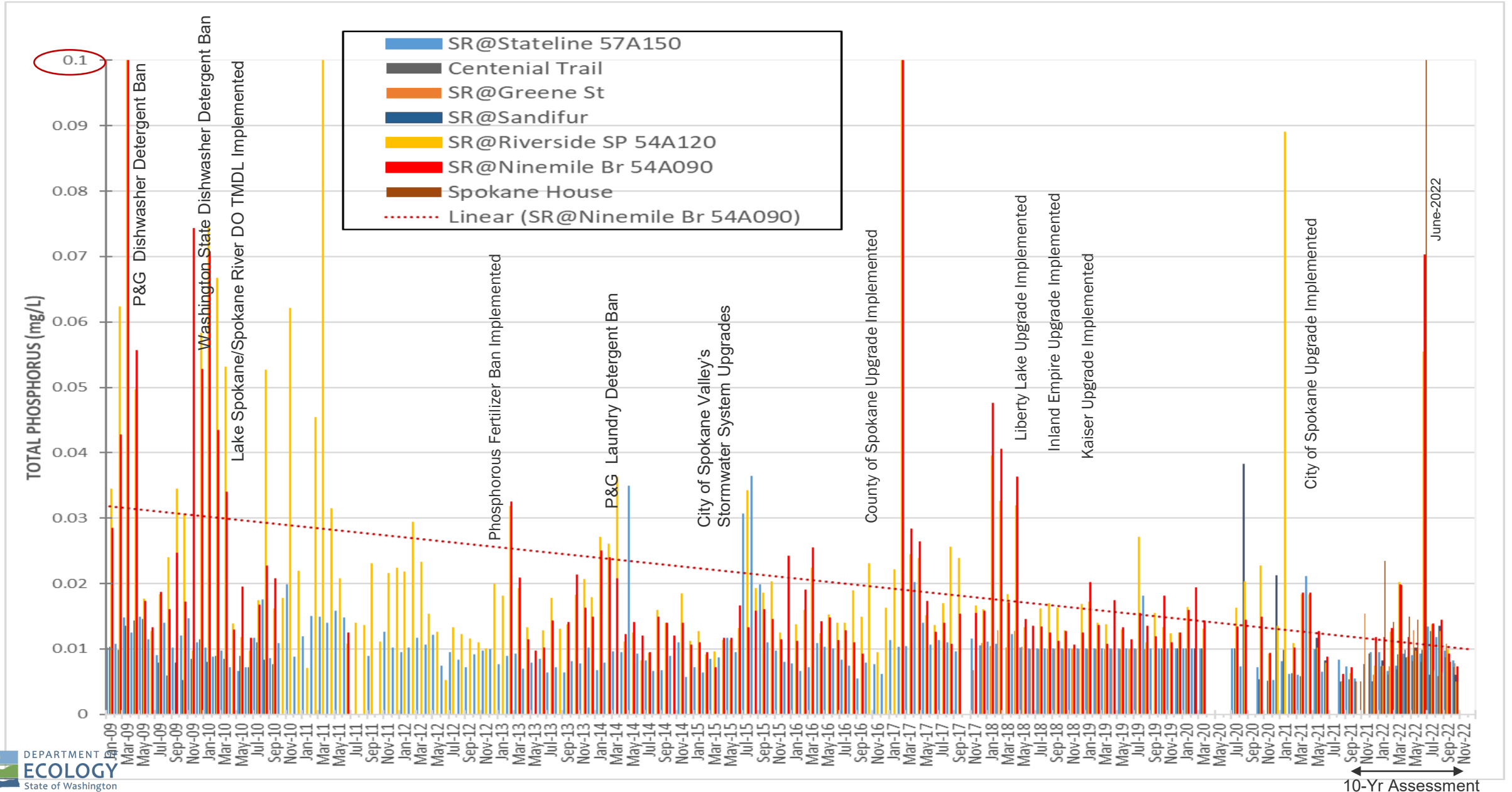


Lake Spokane Water Quality

Preliminary Findings

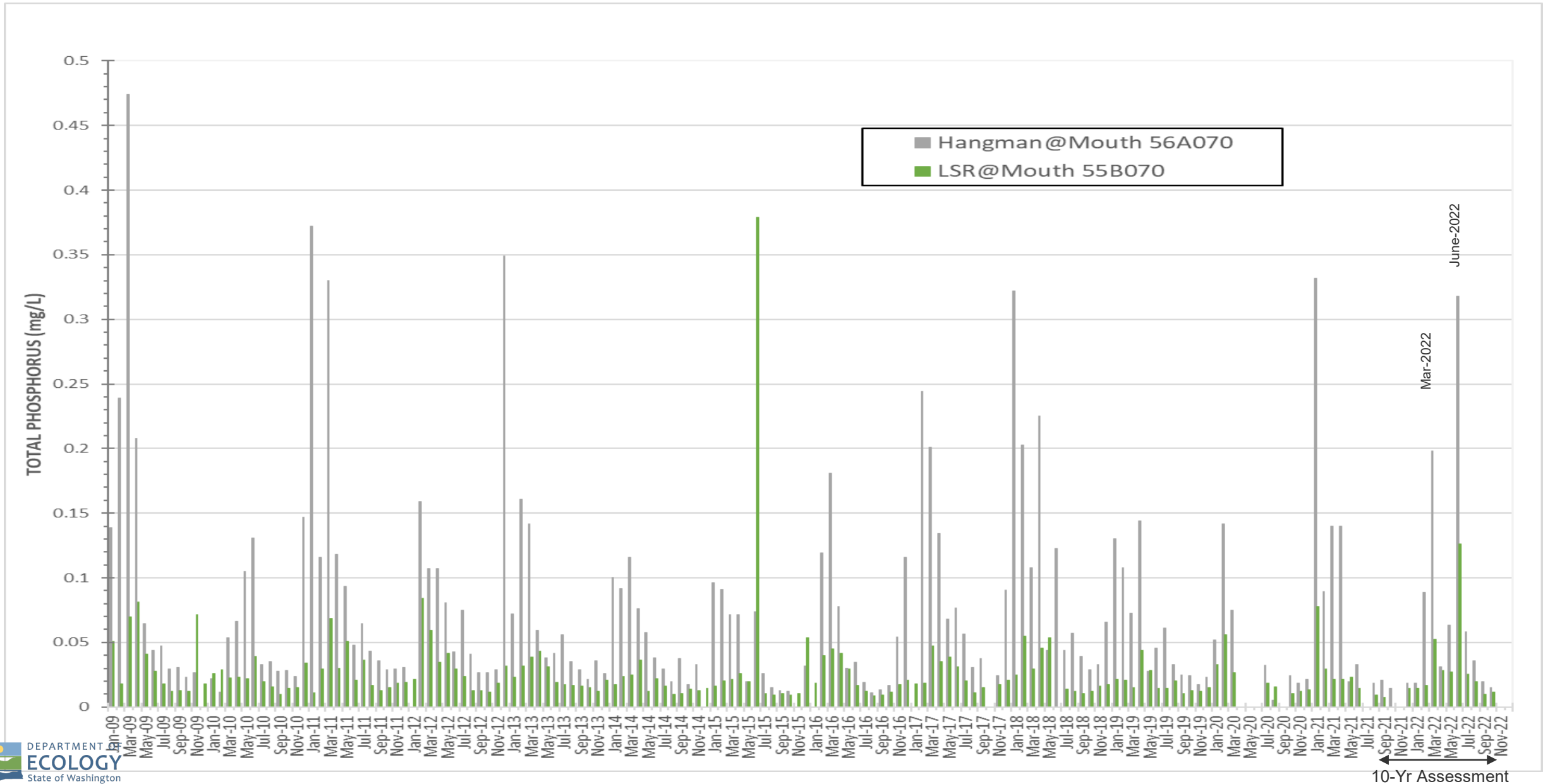
Total Phosphorus - Ambient Monitoring Stations (2009-2022)

(Data Clipped - Absent Hangman Creek and Little Spokane River)



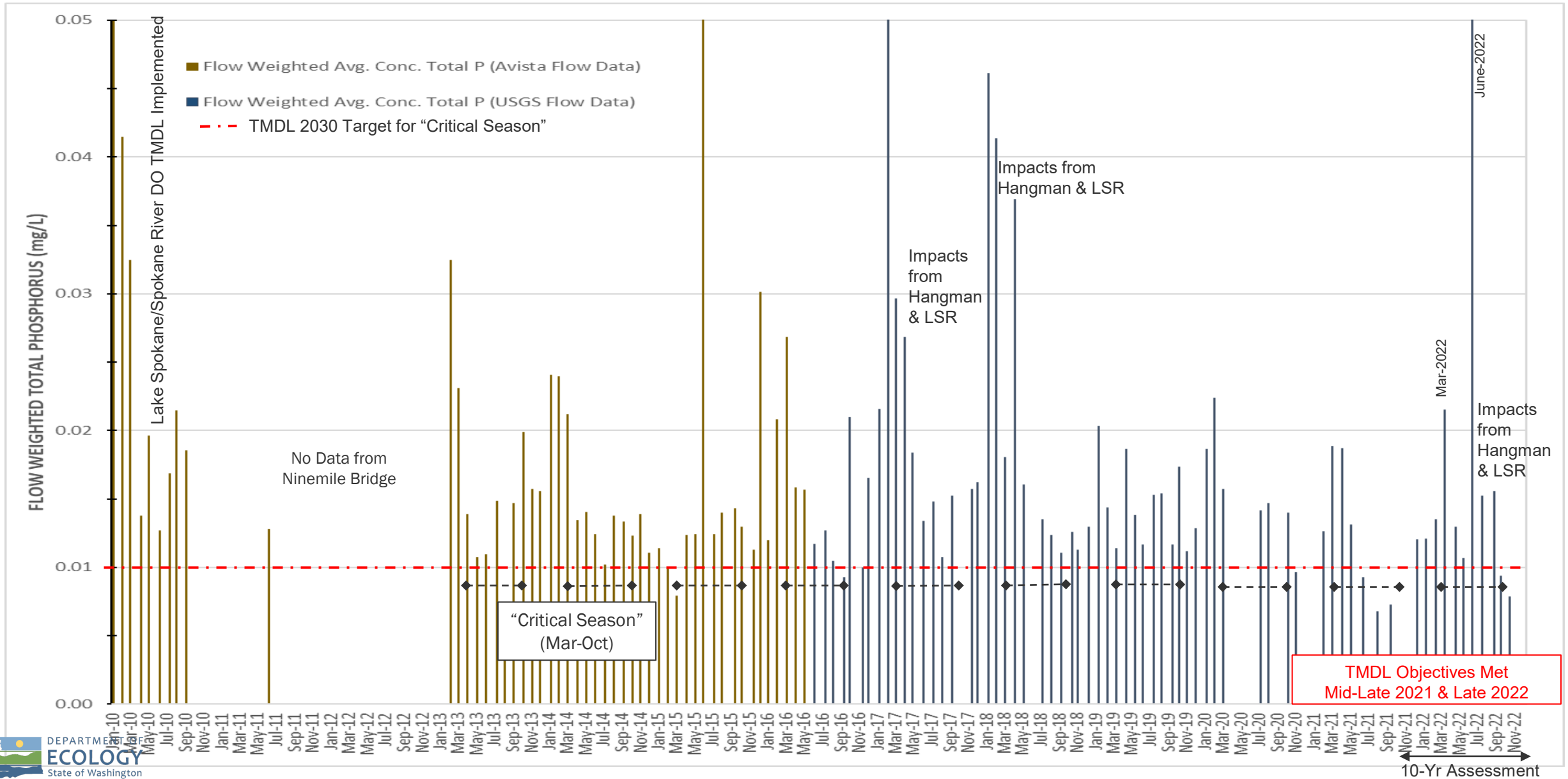
Preliminary Findings

Total Phosphorus - Ambient Monitoring Stations (2009-2022) Hangman Creek and Little Spokane River



Preliminary Findings

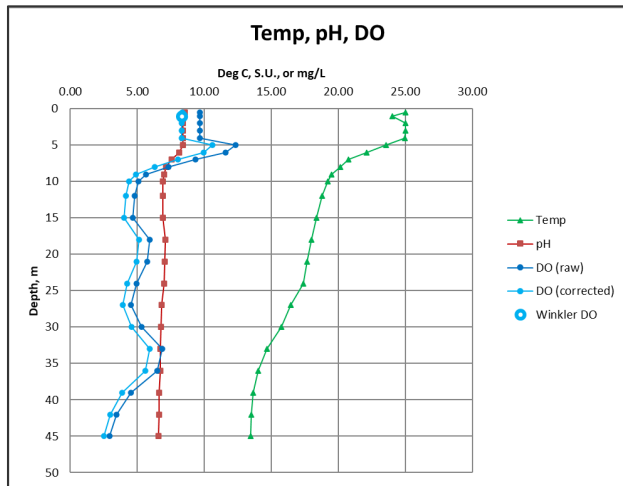
TMDL Flow Weighted Average Phosphorus (2010-2022) (Combined Spokane River @ Ninemile with Little Spokane River @ Mouth)



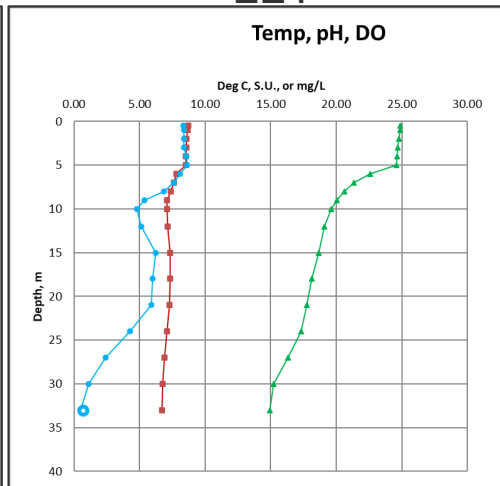
Preliminary Findings

Lake Spokane Profile Data 8-23-2022

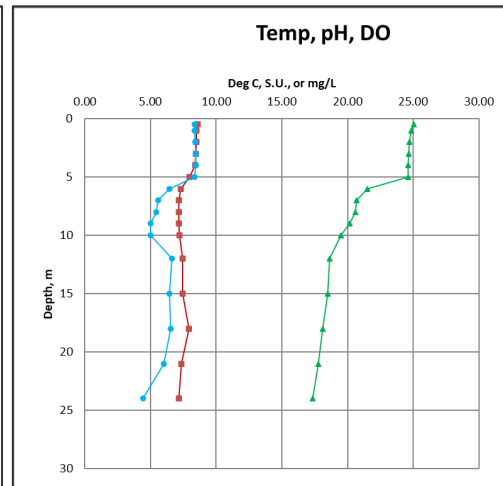
LL0 Near dam



LL1



LL2 Below Tum Tum



Lake Spokane Profile Data 9-27-2022

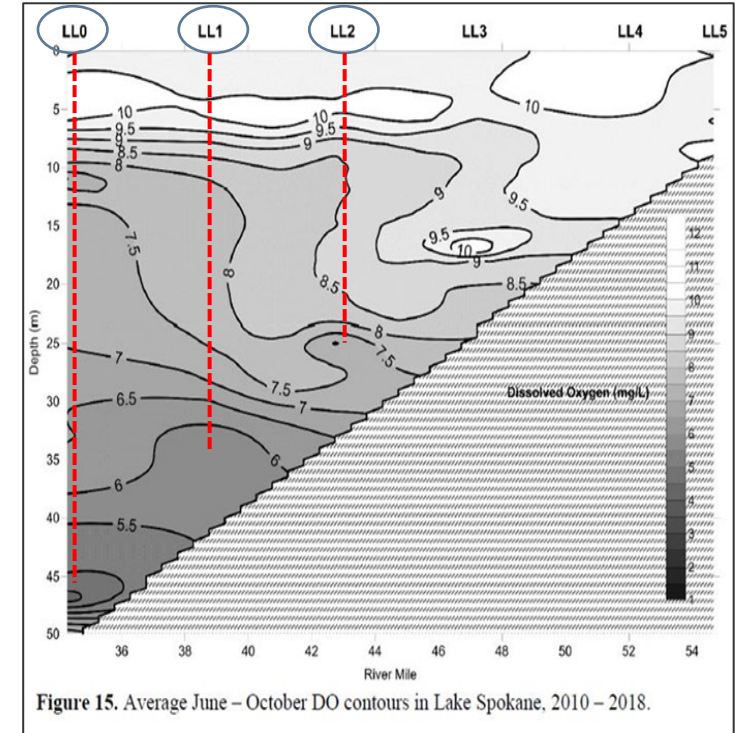
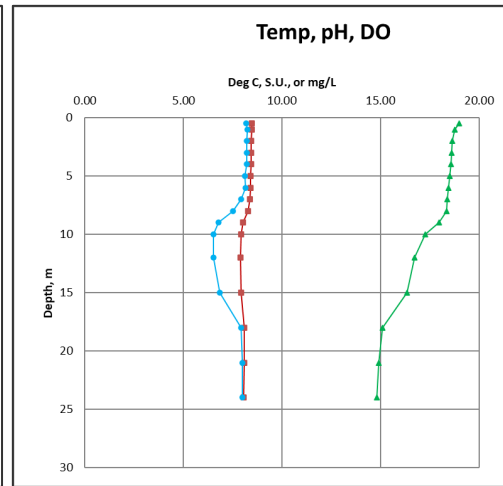
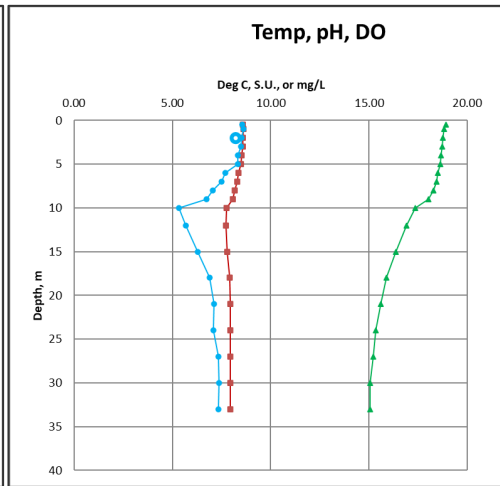
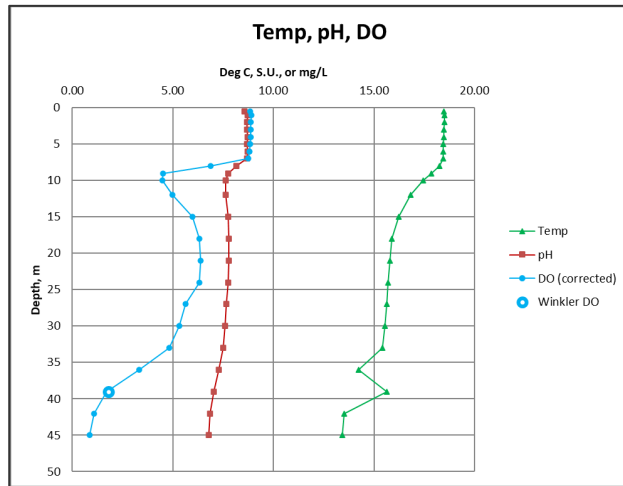


Figure 15. Average June – October DO contours in Lake Spokane, 2010 – 2018.

Source: Avista DOWQAP 2019 Annual Summary 8-Yr Report

YES!!
Better Every Year!!!



It Takes Teamwork



Trust & Planning



New Ideas & Strategies



And of course Money





DEPARTMENT OF
ECOLOGY
State of Washington

